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REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY, 1935

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., August 30, 1935.

HON. HENRY A. WALLACE,
Secretary of Agriculture.

DEAR MR. SECRETARY: I present herewith the report of the Bureau of Biological Survey for the fiscal year ended June 30, 1935.

Sincerely yours,

J. N. DARLING, *Chief.*

INTRODUCTION

THE YEAR'S CHIEF PROGRAM

It cannot be said that any valuable form of American wildlife is in a satisfactory condition at the present time. All have suffered from mankind's indifference or greed, but none is in a more precarious situation than our migratory waterfowl. For this reason practically all lines of work of the Bureau of Biological Survey were to some extent subordinated during the year to the all-important program of waterfowl restoration. Research was extended in order to strengthen the scientific basis of the undertaking; existing wildlife refuges were rehabilitated; regulatory and law-enforcement activities were greatly increased and had as their chief objective the perpetuation of necessary breeding stocks of the various species of wild fowl; and an extensive new migratory-waterfowl restoration program was launched.

The important place of wildlife in land-planning uses was stressed, and its needs have become more generally understood by those in charge throughout the Government. Conditions that favor wildlife and promote the perpetuity of wilderness areas are now widely recognized as being identical with those that alleviate the effects of drought, provide for flood control, and prevent soil erosion. The Bureau has effectually demonstrated that plantings to nullify harmful wind action, to conserve moisture, and to reduce the run-off from rainfall and melting snow are also wildlife-conservation measures. A timely article bearing on another aspect of wildlife restoration and widely distributed was published in the 1935 Yearbook of Agriculture (pp. 220–221) under the title "Game as a Farm Crop Emphasized by Agricultural Adjustment."

The waterfowl restoration project also dovetailed with the emergency relief programs of the Government. Great numbers of individuals who would otherwise have been in dire need were employed on work for refuge acquisition and improvement, and, through control of injurious species of wildlife, on work not only for improved production in agriculture and stock raising but for the welfare of valuable game and other species of the wild native fauna.

The public is beginning at last to understand that in many instances the former domain of wildlife has been needlessly taken from it, frequently with no permanent benefit to man. It is now generally known that it is possible to have our wildlife, our forest and wilderness areas, and our natural water reservoirs and still attain vastly higher levels of crop production than in the past. There is land enough to meet generously every national need, every requirement of agriculture, industry, and recreation, and at the same time to restore great acreages of submarginal lands to their best uses—waterfowl,

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fur, and fish production. And it has been demonstrated that the restoration of marshlands to these primitive uses has advantages not only to the wildlife resource but also to man. Furthermore, land better adapted to wildlife than to farming may actually, if indirectly, through its attractiveness to sportsmen, hunters, trappers, and nature students, support more people in a correct than in an incorrect use. It is on these principles that the migratory-waterfowl restoration program has been based.

Wild-fowl conservation by reducing the annual kill by hunters has also been stressed as part of the restoration program. During the 1934–35 season the shooting of waterfowl was restricted to 30 days between October 1 and January 13, and among other restrictions was the prohibition of baiting waterfowl to blinds and shooting stands, except under permit from the Secretary of Agriculture. Studies of the needs of waterfowl were continued, with the result that on July 30, 1935, after the close of the fiscal year covered by this report, the most rigid regulations in the history of American wildfowling were promulgated for the fall and winter of 1935–36. The country was divided into a northern and a southern zone, with only a 1-month continuous season in each, with shooting hours from 7 a. m. to 4 p. m.; daily bag limits were further reduced and the possession limit made the same as the daily bag; sinkboxes and open-water shooting, as well as bait and live decoys, were prohibited for waterfowl hunting; and automatic repeating guns carrying more than three shells were ruled out by a regulation approved on February 2. These hunting methods were discussed in an article in the 1935 Yearbook of Agriculture (pp. 328–330) under the title "Waterfowl Problems Clarified by Study of Gunning Practices." The year's chief program has thus been threefold—waterfowl restoration, refuge establishment, and law enforcement, with particular attention to the restoration program.

The continuing migratory-waterfowl program involves acquisition by the Bureau of a million acres in each of the fiscal years 1935–36 and 1936–37. This will bring the total number of Survey refuges to more than 200, involving 4,500,000 acres of wildlife-refuge land, more than 3,600,000 acres primarily of value to migratory waterfowl. The complete rehabilitation of our country for the needs of migratory waterfowl, without conflicting with other agencies and without appreciable industrial or economic loss, requires the restoration of 7,500,000 acres, now held in uneconomic or insufficiently productive industrial or agricultural use.

Preliminary surveys have revealed that there are at least 20 types of submarginal land available for refuge purposes. It was early determined, however, that the waterfowl situation would not be helped merely by purchasing an area that is still naturally good and productive, but rather by restoring devastated areas formerly known to have a good waterfowl history and an important annual waterfowl production.

This is the program that the Biological Survey hopes to achieve by 1940. With the present trained force available, and with a continuance of the sympathetic interest and support of the various emergency programs, of State conservation departments and conservation societies, and of the thousands of sportsmen who annually depend upon migratory waterfowl for a few days' enjoyable sport afield, this is not an unattainable goal, but one of imminent practical approach and affording hope for reasonably speedy consummation.

REGULAR AND SPECIAL FUNDS AVAILABLE

Funds for financing the Bureau's operations have increased from the first appropriation 50 years ago of $5,000 to an approximate average for each of the past few years of a million and a half dollars in regular funds. For the year covered by this report, the regular appropriation had been reduced to $1,054,084, but the Bureau's program was financed by allotments from emergency funds aggregating $8,500,000, and by proceeds of about $600,000 from the sale of migratory-bird hunting stamps, and during the last month of the year a special appropriation for wildlife-refuge establishment of $6,000,000 was made, to continue available until expended. In addition, for the past 20 years the Bureau has administered cooperative funds for mammal-pest control that have frequently far exceeded the appropriations made by Congress for the purpose.

The money obtained by the Bureau during the year from various emergency appropriations gave great impetus to the long-needed refuge-acquisition and development program. It provided the most noteworthy contribution the Fed-

eral Government has ever made to wildlife. An emergency-conservation fund of $1,000,000 for acquisition of refuge lands was practically entirely obligated, and approximately $2,100,000 of a $2,500,000 fund for rehabilitation of new and old refuge areas was either expended or obligated. The authorization for the use of these funds expired on March 31, considerably less than a year after the money was actually made available, and the time limit precluded the wise expenditure of the $400,000 balance, which was thus allowed to revert to the Treasury. Nearly all of a fund of $5,000,000 earmarked by the Federal Emergency Relief Administration for purchase of migratory-waterfowl refuge areas was obligated, resulting in the obtaining of a group of the most outstanding waterfowl-refuge areas in the country.

Valuable and highly appreciated cooperation and sympathetic consideration were received from the Federal Emergency Relief Administration, the Public Works Administration, the Emergency Conservation Work organization, and the Resettlement Administration, and the Bureau in turn planned its activities to assist in the Government's recovery program.

SEMICENTENNIAL RÉSUMÉ

With the end of the year 1935 marking the semicentennial of the establishment of the organization now known as the Bureau of Biological Survey, it is appropriate to present in the annual report for this year a brief glimpse of the Bureau's history, the details of which are to be found in the preceding 49 annual reports. Instituted on July 1, 1885, as a Branch of Economic Ornithology in the then Division of Entomology, and made a full Division of Economic Ornithology and Mammalogy 1 year later, this organization for the first 15 years was given over almost wholly to the research covered by its designation. Continuing to the present, this function has expanded with the delegation to the Bureau of enlarged duties—in 1900 game protection, 3 years later the beginning of administration of bird refuges, in 1915 cooperative control of predatory animals and injurious rodents, and 3 years later execution of the Federal Government's responsibilities in the protection of migratory birds under international treaty. During the past 2 years increased attention has been given to the needs of migratory game birds, this year by the institution of the extensive program of restoration of migratory waterfowl.

The present designation of the Bureau (Division of Biological Survey in 1895, with bureau status 30 years ago) recognizes a basic line of its scientific work—making biological surveys of States and of other large areas within natural boundaries. The results of its research, service, and regulatory activities have been published in numerous bulletins and circulars; in its own technical series, the North American Fauna; and in the annual reports of its Chiefs, as follows: 1885 to 1909, by C. Hart Merriam (except 1898 to 1901, by the Acting Chief, T. S. Palmer, and in 1906 by the Acting Chief, Henry W. Henshaw); 1910 to 1916, by Henry W. Henshaw; 1917 to 1926, by Edward W. Nelson; 1927 to 1933, by Paul G. Redington; and 1934 to 1935 by the present Chief.

The net results of the work over the past half century have been reflected in an increasingly conservation-minded public, as the Bureau has developed and published the facts regarding the economic, recreational, and esthetic values and the requirements of wildlife; in the building up of a public sentiment that has made possible the necessary but heretofore unheard-of restrictions on the hunting of wild fowl and the trapping of other game and fur animals; in the service to agriculture, horticulture, stock raising, and forestry worth millions of dollars annually, through demonstrations and cooperation in the suppression on a scientific basis of wild-animal hindrances to production; and in the reservation, acquisition, and administration of a now rapidly increasing number of bird refuges and big-game preserves established at strategic points in the former domain of the native fauna for the perpetuation of adequate representatives of the various species.

Reorganization of the Bureau during the past year and rehabilitation of its work have added impetus to its program of wildlife conservation and have measurably increased public support and cooperation in furthering its definitely stated objectives.

There was no official observance of the Bureau's semicentennial, but a dinner to celebrate the event was arranged by a committee of the personnel in February, attended by the Secretary and other officials of the Department, representatives of Congressional wildlife-conservation committees, the first Chief of the Bureau, and former and present members of the force. The Division of Public Relations

in two numbers of the Bureau's mimeographed house organ, also issued a brief history of the founding of the Bureau, written for the purpose by its first chief, Dr. Merriam, and a résumé of the research operations of the personnel during the first 20 years. It is planned to combine these in a mimeographed leaflet with any similar articles that may be written in further celebration of the semicentennial of the Government's "wildlife service", to place the facts on record for the information of cooperators and others interested.

THE PRESENT ORGANIZATION

Since the reorganization of the Bureau on July 1, 1934, and the consolidation of service and regulatory units in the Division of Game Management and of scientific sections in the Division of Wildlife Research, mention of which was made in last year's report, technical research work on mammals has been segregated in a new section of mammalogy; specialized sections have been erected in the Divisions of Land Acquisition and Migratory Waterfowl, and administration of bird refuges has been placed under the Division of Migratory Waterfowl, the big-game preserves being continued under the Division of Game Management. The present organization of the Bureau, with officials in charge, is as follows:

Chief---J. N. Darling
Associate Chief---W. C. Henderson
Technical adviser---W. L. McAtee
Division of Administration---W. R. Dillon
Assistant---T. E. Jacoby
Section of Personnel and Pay Rolls---E. J. Thompson
Section of Accounting---S. C. Moore
Section of Purchases and Property---J. L. Talbert
Section of Mails and Files---W. D. Hobbs
Division of Public Relations---H. P. Sheldon
Assistant, in charge of Editorial and Information Section---W. H. Cheesman
Section of Visual Information and Publication Distribution---Lisle Morrison
Division of Wildlife Research---W. B. Bell
Assistant---I. N. Gabrielson
Section of Mammalogy---H. H. T. Jackson
Section of Distribution and Migration of Birds---F. C. Lincoln
Section of Food Habits---Clarence Cottam
Section of Fur Resources---Frank G. Ashbrook
Section of Disease Control---J. E. Shillinger
Division of Land Acquisition---Rudolph Dieffenbach
Section of Appraisals and Negotiations---R. M. Rutherford
Section of Surveys and Maps---A. A. Riemer
Division of Migratory Waterfowl---J. C. Salyer, II
Assistant, in charge of Section of Maintenance and Patrol---A. C. Elmer
Section of Reconnaissance and Habitat Improvement---W. F. Kubichek
Section of Restoration and Development---Amos B. Emery
Division of Game Management---Stanley P. Young
Assistant, in charge of Section of Big Game Refuges and Game Agents---W. E. Crouch
Section of Law Enforcement---F. P. Callaghan
Section of Importations and Permits---R. W. Williams
Section of Predator and Rodent Control---A. M. Day

RETIREMENTS OF VETERAN WORKERS

Two veteran scientists of the Bureau were retired during the year—Edward A. Preble, on June 30, after 43 years' service, and Stanley E. Piper, on May 31, after 31 years. Mr. Piper, whose work had been concerned chiefly with the relation of native and other species to agriculture in the West, was the author of several publications on field-mouse control. Mr. Preble's work covered all phases of natural-history research, including field surveys in many States and Canada, and on the Pribilof Islands, Alaska. He was the author of a number of technical and other bulletins, including several numbers of the North American Fauna, his outstanding work (no. 27 of that series) reporting in 1908 on A Biological Investigation of the Athabaska-Mackenzie Region.

OUTSTANDING EVENTS OF THE YEAR

The events that marked the fiftieth year's work of the Biological Survey may be briefly summarized as follows:

Reorganization.—Beginnings of the Bureau's operations under the reorganization of divisions and sections effective July 1, 1934 (see organization list above).

RESEARCH ACTIVITIES

Game-management research.—Completion of plans for a program of wildlife research, demonstration, and education, through cooperation with selected land-grant colleges and State game commissions in representative parts of the United States; and extension of cooperative studies on national forests.

New research station.—Transfer to the Biological Survey of administration of the Wichita National Forest and Game Preserve (Okla.), for use as a wildlife refuge and research station, for the maintenance and study of buffalo, elk, deer, Texas longhorns, game birds, and other wildlife.

Waterfowl-habitat studies.—Continuation of studies of waterfowl conditions in the United States, Canada, and Mexico, publication of data on the status and needs of waterfowl, and recommendations for controlling introduced aquatic-plant pests and modifying mosquito-control operations where detrimental to wild-fowl food plants and habitat.

Fur production.—Importance of the fur resource emphasized in land-management policies, and research on suitable species broadened on waterfowl refuges that afford good fur-animal habitat.

WATERFOWL RESTORATION

Refuge land acquisition.—Completion of examination and appraisal of approximately 1,000,000 acres of proposed refuge lands, and consummation of negotiations for the acquisition of 925,570 acres, at an average cost of $8 an acre.

Waterfowl program.—Important areas restored for waterfowl use under the program instituted through the new Migratory Waterfowl Division.

Special funds.—Allotment of $8,500,000 in emergency funds for use at the beginning of the year for refuge acquisition and development, and appropriation of $6,000,000 in June for expansion of the program.

Cooperation in land use.—Quickening of interest in wildlife problems by all Government agencies having large-scale field operations.

Refuge development.—Successful completion of numerous projects for the development and improvement of waterfowl and other wildlife refuges under National Recovery Administration and other allotments, and allocation of 26 Civilian Conservation Corps camps for such work.

LEGISLATION AND REGULATIONS

New legislation.—Approval on June 15, 1935, of an act amending for improved administration purposes several laws administered by the Bureau for wildlife conservation; appropriating funds for acquisition of lands for wildlife refuges, and authorizing further allotments from emergency relief funds for the purpose; enlarging the powers of the Secretary in refuge administration; and providing for State participation in receipts from such administration.

Baiting.—Control of principal abuses of waterfowl baiting under a system of permits issued by the Chief of the Biological Survey, and requiring reports thereon for the 1934–35 season.

Law enforcement.—Completion of the first year's work by "flying squadrons", under which it was possible effectively to patrol large waterfowl concentration areas; apprehension of 48 duck sellers along the Illinois River; and a vigorous drive in California against clubs and restaurants selling game.

Waterfowl hunting seasons.—Complete readjustment of the 1934–35 waterfowl seasons and reduction of hunting from 60 to 30 days, spread over the period October 1 to January 13.

Collecting permits.—Revocation of all outstanding scientific collecting permits for migratory birds and reissuance on the annual basis to insure against misuse.

PREDATOR AND RODENT CONTROL

Predators.—Increases reported in abundance of predatory animals, although more were destroyed than ever before.

Rodents.—Reduction of the numbers of injurious rodents on 11,166,935 acres for the protection of farm crops, range grasses, silvicultural plantings, reclamation-project waterways, and surface soils threatened by erosion, through extension of cooperation with Federal bureaus and emergency organizations.

RESEARCH ON THE STATUS AND DISTRIBUTION OF WILDLIFE

WATERFOWL STUDIES

An extended and intensified investigation of waterfowl conditions during the summer of 1934 covered breeding grounds in the United States from Minnesota west to the Pacific coast, important parts of Canada, and wintering areas in Mexico. Canadian observations by four field parties were made on breeding grounds in British Columbia, Alberta, Saskatchewan, and Manitoba, and extended north to Lake Athabaska. The condition of the birds was found to be most unsatisfactory, and the facts developed demonstrated that the additional restrictions on hunting were fully justified. In practically all the drought region duck production was reduced almost to zero. The status of the birds in northern areas not affected by drought was discussed in an article in the 1935 Yearbook of Agriculture (pp. 326–328) under the suggestive title "Waterfowl Breeding Grounds of Far North Now Poorly Tenanted."

In Mexico investigations were conducted by two experienced representatives from December 1934 to the last of April 1935, from the Valley of Mexico south to Yucatan and the Guatemalan border. These men found that ducks have decreased greatly over all of these important wintering grounds. The fact, however, that there has not been a comparable increase in destructive factors in that country, clearly indicates that the losses are traceable to conditions in the United States and Canada.

The fall migration of 1934 was reported on by the regular personnel of the Bureau and by 498 volunteer observers, and during the week of January 21, 1935, a simultaneous waterfowl inventory was made by all available personnel throughout the country. Though some of the worst storms of the season prevented the results from reaching expectations, important information was obtained and the experience gained in setting up the organization will prove valuable in further studies. Plans are being made to expand aerial observations during the coming winter, in cooperation with the Navy Department, as seaplanes were found of great advantage on relatively calm days in checking at low altitudes the concentrations of diving ducks and others in large rafts on open water. The spring migration of 1935 was covered by 450 strategically located volunteer observers, and 5 field parties continued investigations of waterfowl in Canada during the 1935 nesting season.

BANDING GAME AND OTHER BIRDS

Banding operations continued to yield valuable information and were carried forward actively, particularly with waterfowl. Birds to the number of 249,829 were reported as banded during the year. For the first time the total fell below that of a preceding year, but it was not surprising, as there has been evidence that, probably as a result of lowered reproduction caused by drought, the smaller seed- and insect-eating birds have been present in greatly reduced numbers at important banding stations. Furthermore, it had been necessary to restrict the issuance of new banding permits. The number of cooperators has remained nearly stationary, at about 2,000, new permits issued in exceptional cases just about balancing the losses.

The number of return records of banded birds, 16,913, was also somewhat less than that reported in 1934, but it is significant that the percentage of usable data has been much greater as the number of banded birds is now well over 2,000,000.

The total number of waterfowl banded, however, showed an increase—42,427 for 1935 as against 40,524 for 1934. The pintail again occupies first place, with 15,177. The numbers by species are shown for the 2 years in table 1. The figures presented, however, should not be construed as representing the relative numerical status of the different species, or as indicating an increase or decrease in abundance.

Among nongame birds banded, the list is headed by the common tern, with 22,315, followed by the junco, with 15,486. The latter species is one of the most abundant North American birds, occurring everywhere and often in flocks of large size. Leading in numbers among the groups rather difficult to band are more than 2,000 herons of 10 species; more than 1,800 hawks, owls, and vultures of 30 species; and more than 2,000 shore birds of 24 species. Of the 378 species represented, 10 are new to the list of banded birds.

The significance of birdbanding was depicted in a motion-picture film released during the year, entitled "The How and Why of Birdbanding."

TABLE 1.—*Waterfowl banded in the fiscal years 1934 and 1935*

Species	1934	1935	Species	1934	1935
	Number	*Number*		*Number*	*Number*
American merganser	1		Greater scaup	163	156
Red-breasted merganser		8	Lesser scaup	2,045	1,299
Hooded merganser	2	5	Ring-necked duck	866	1,073
Mallard	9,424	14,937	Goldeneye	14	3
Black duck	7,618	4,037	Bufflehead	6	84
Gadwall	245	85	American eider		22
Baldpate	1,051	689	White-winged scoter		2
Green-winged teal	2,521	2,307	Ruddy duck	7	15
Blue-winged teal	146	973	Snow goose	19	73
Cinnamon teal	304	42	Blue goose	176	53
Shoveler	110	75	White-fronted goose		1
Pintail	14,290	15,177	Canada goose	193	302
Wood duck	293	435	Whistling swan	2	1
Redhead	635	350			
Canvasback	393	213	Total	40,524	42,427

RECORDS AND MAPS OF BIRD DISTRIBUTION

Accumulated migration-record cards of the past 2 years, to the number of more than 95,000, have been distributed by species, and the further break-down by States and other major political divisions is progressing as rapidly as use of the cards in mapping will permit. Maps portraying the breeding and wintering ranges of migratory waterfowl, shore birds, and other important groups are being maintained as nearly up to date as possible. Migration reports to the number of 200 were reported during the year from volunteer cooperators, continuing in many cases regular reports on the same areas over long terms of years.

STATUS OF UPLAND GAME BIRDS

Data are being collected from the game departments relative to the present status of upland game birds in the several States. An excellent spirit of State cooperation has been shown, and when all reports have been received it will be possible to present the first Nation-wide study of its kind.

RESEARCH ON BIG-GAME MAMMALS

ELK HERDS

In cooperation with the Forest Service and the State Game Commission of Wyoming, a count of elk in the Jackson Hole country revealed 22,035 animals. At the request of the Forest Service, further studies were made of the elk and of grazing conditions in the Sun River section and part of the Flathead drainage in Montana, of winter ranges north of Yellowstone National Park, and on adjacent parts of the Absaroka National Forest, to assemble data as a basis for elk-management practices. The Absaroka range used by elk and by other big game was found so severely overgrazed that temporary reduction of the herd and the development of other grazing areas were recommended. A considerable reduction was effected during the fall and winter by liberalized hunting regulations.

To obtain specific information on elk and to correlate the findings for the entire western United States, with a view to rounding out information required for a comprehensive report on the elk of North America, studies of the species were made also in Idaho, Nevada, California, Arizona, and Utah. Of special interest was the examination of the habitat of the coast elk in northwestern California, the Tule elk herd near Bakersfield, Calif., and the ancient ranges of the now extinct Merriam elk in Arizona, where Rocky Mountain elk have recently been introduced. Particular attention was given to the relation of elk and livestock grazing. During February and March investigations were made of the Roosevelt elk on various ranges of the Olympic Mountains and the condition of the food supply, especially in winter, which is the key to the situation. As a result of this study necrotic stomatitis was determined to be the principal cause of winter losses in the Olympic section, and occurrence of this disease was definitely correlated with overpopulation and consequent overbrowsing. The findings were reported to the Forest Service, to the National Park Service, and to game authorities of the State of Washington.

"Why Save the Elk?" is the title of a motion picture completed and released during the year for visual information on this important big-game project.

WICHITA WILDLIFE

A study of the game, fur bearers, and other wildlife was made on the Wichita Mountains, in Oklahoma, where the Biological Survey will maintain a wildlife research station (p. 38). Observations were made of the numbers of buffalo, elk, and deer, as well as of Texas longhorns, wild turkeys, lesser prairie chickens, grouse, and quail. The need was noted of increasing food and cover plants and making improvements through construction of dams to provide small lakes, and through food plantings, of trees, shrubs, or grasses, as a means of increasing the wildlife carrying capacity of the area. Further research and experiments will be carried out to obtain the basic information required for management practices on this area, and on other parts of the Great Plains region to which the results may be applicable.

MOUNTAIN SHEEP

The serious problems confronting the mountain-sheep population of the western United States led to more extended studies of the various herds, to gather data on their numbers, food supply, and diseases, and particularly the need for setting aside suitable refuges on national forests and the public domain, where these valuable game animals may be more adequately protected and provided with food, cover, and range.

MINNESOTA CARIBOU

Observations made of the caribou in northern Minnesota indicated that under the efficient program of protection now provided by the State this herd is continuing in a thrifty condition and may increase in numbers.

FOREST WILDLIFE RESEARCH

Wildlife conditions were studied on the Superior National Forest in Minnesota during the fall and again during the spring, three experienced field naturalists being engaged on each occasion. This investigation was designed to provide information regarding the abundance and distribution of the forest wildlife, particularly the valuable upland game, waterfowl, and fur bearers, and the predatory animals, as a basis for a wildlife-management plan for the forest.

Four naturalists were employed during the year in a study of the relationships of wildlife to forestry, grazing, and other land use in cooperation with certain of the forest experiment stations. Special attention has been given to the relationship of rodents and birds to forest reproduction, particularly with reference to damage to seeds and to seedlings and other plants during periods of heavy snow. Facts regarding cyclic abundance and scarcity of valuable and harmful species were assembled, snowshoe hares were marked for record purposes, and trapping was intensively carried on. This work was closely correlated with disease investigations in progress.

In New England, studies of wildlife management in controlled forest areas have been continued. In this work Civilian Conservation Corps labor has been utilized in clearing tracts, cleaning out underbrush, and making plantings on the Pillsbury State Forest in New Hampshire. The aim has been to coordinate silvicultural methods with game management in order to effect the maximum production on forested areas.

At the request of the Forest Service, biologists again made inspections and recommendations on the work being done by the Civilian Conservation Corps camps on national forests in the Eastern and Southeastern States, and arrangements were made for employing wildlife technicians to recommend procedure for safeguarding and improving the welfare of the forest wildlife. The importance of the forest fauna was described in the 1935 Yearbook of Agriculture (pp. 221–223), in an article entitled "Game Management and Forest Protection are Related Tasks."

COOPERATIVE RESEARCH IN WILDLIFE MANAGEMENT

Plans were completed at the end of the year for initiating nine combined wildlife research, demonstration, and educational units in various representative regions, in cooperation with land-grant colleges and State game commissions. These projects will be for the purpose of conducting fundamental investiga-

tions, applying the results to local wildlife-management conditions, and carrying them to landowners, both public and private, by demonstration and extension methods. The Bureau will thus have a direct method for getting the results of its wildlife research into the hands of educators, students of wildlife management, farmers, and others concerned with land-use programs, who need and will apply the findings in the improvement of wildlife conditions.

WILDLIFE INVESTIGATIONS IN ALASKA

MUSK OX HERD

The musk ox herd has continued to thrive and multiply. Last year, for the first time since its introduction into Alaska in 1930, 7 calves were born, 1 being stillborn and 1 killed by another animal, and this year calving began 10 days earlier than last year, namely, on April 19, and the total calf crop was 12, but 2 were stillborn. The 5 yearlings from last year's crop have made a growth within their age class superior to that of the animals originally introduced. Each adult cow gave birth to a calf this year, but in one case of stillbirth the cow also died. At the close of the year the herd consisted of 12 adult bulls, 11 adult cows, 4 male and 1 female yearlings, and 10 calves, a total of 38. This increase of 4 over the original number of 34 introduced 5 years ago means that the herd has recouped its losses, has been carried through the period of growth to maturity, and is now reproducing satisfactorily.

It has been determined that the musk ox does not breed until 4 years of age and calves at 5 years. A definite observation of an individual breeding and calving demonstrated that the gestation period is 8 months, rather than 9 months, as previously thought.

Added knowledge of handling, the clearing of underbrush and down timber from the pasture, and the building of fences to control the movements of the herd eliminated losses from predators. With increasing age, however, the adults are proving less tractable to handling by herders on foot, and it is necessary to devise management practices for reducing the risk of injury to both animals and herders.

At the close of the year arrangements had been made in cooperation with the Alaska Game Commission to ship 2 adult bulls and 3 adult cows to Nunivak Island, where they will be released as the nucleus for building up a musk ox herd on this reservation. As the original herd grows in numbers and funds become available, it is planned to distribute the animals to other favorable localities as a means of building up separate herds, thus reducing the possibilities of losses from epizootics.

REINDEER, CARIBOU, AND OTHER WILDLIFE

Studies were made of reindeer, caribou, and associated grazing problems. Range reconnaissance work on plants for wildlife food was continued, and information was assembled regarding the status of waterfowl and other game birds, big-game animals, and fur bearers in various sections. A marked increase of certain birds, rodents, and rabbits was observed locally in the Territory, and it seemed apparent that the upswing in the cyclic abundance in these forms was in progress, following a period of scarcity.

A publication entitled "Raising Reindeer in Alaska" was issued during the year (Misc. Pub. No. 207); a plan for the management of the brown bear in relation to other resources on Admiralty Island was published in cooperation with the Forest Service (Misc. Pub. No. 195); and a comprehensive report on the Alaska-Yukon caribou was completed and at the end of the year was in course of publication as North American Fauna No. 54.

SCIENTIFIC REFERENCE COLLECTIONS AND RECORDS

Continued progress was made in assembling and recording biological data based on collections of specimens and reports regarding life histories, habits, and distribution of mammals as well as of birds. During the fiscal year 113 mammal specimens were added to the Biological Survey collection, and 758 were identified for 34 institutions and individuals in 19 States and 1 foreign country. Specimens to the number of 120 have been borrowed for study from 8 institutions in 6 States and 1 foreign country, whereas loans were made of 1,651 specimens to 10 institutions and individuals in 9 States and 1 foreign country. The facilities of the mammal laboratories were utilized by 30 re-

search workers from 15 States, Alaska, and 2 foreign countries. Scientists of the Bureau, using these collections, described two new mammals, belonging to the genera *Reithrodontomys* and *Neotoma*. Mammal type specimens in the collection now number 908.

During the year, 662 bird specimens were added to the collections, chiefly from North Carolina, Georgia, and Virginia. Technical studies and identifications of 705 specimens were made at the request of museums, educational institutions, other organizations, and research workers, including members of the Bureau staff and others studying economic problems, and 340 specimens were lent to specialists engaged in technical regional studies of faunal problems. Assistance also was given many ornithologists who were preparing State or regional reports for publication.

Of outstanding importance among technical reports on selected groups of areas were the completion for publication of a report on the mammals of Oregon, based on many years of investigation, and of a manuscript embodying research on the classification and distribution of the economically important group of American ground squirrels (genus *Citellus*). Progress has been made on a technical revision of the mountain lions and on a taxonomic and distributional study of arctic hares.

In connection with efforts now being made to restore land and water areas that have been unwisely drained or put to other agricultural uses, there has been an urgent demand for dependable information regarding the occurrence and distribution of the wildlife species affected. The files of information assembled by field naturalists and laboratory workers of the Biological Survey for 50 years contain a vast fund of information regarding the former and present status and the ranges and movements of practically every known species of North American bird or mammal. Several million card records, systematically arranged, have proved of the utmost value in connection with the preparation of a special series of maps of the present and former ranges of important species.

Based partly on birdbanding operations, partly on special field studies during the past 2 years, and partly on data previously assembled and classified in the Bureau's files, there were published during the year a circular (no. 342), on The Waterfowl Flyways of North America, and a publication (Misc. Pub. 210), on the Status of Waterfowl in 1934. A motion-picture film also was completed and released under the title "Flyways of Migratory Waterfowl." A series of lectures on wildlife and conservation topics by a Bureau ornithologist over a period of 4 months in 21 States also served to give the public a better understanding of the program and accomplishments of the Survey and met a distinct demand.

ECONOMIC STUDIES OF WILDLIFE

INVESTIGATIONS OF WATERFOWL FOOD RESOURCES

EFFECTS OF MOSQUITO CONTROL ON WILDLIFE HABITAT

Naturalists of the Bureau devoted much effort during the year to determining the effects of mosquito control and drainage projects on waterfowl food and cover. Such projects have been undertaken all over the country as a means of providing relief labor. In many instances the work was done without proper consideration of wildlife interests or adequate supervision, and valuable forms of wildlife have suffered. Some of the most destructive results occurred where good waterfowl areas were needlessly drained under the guise of mosquito control. Vigorous efforts have been made to prevent unnecessary undertakings and the further destruction of the food resources of valuable aquatic forms of wildlife. Attention has been given to harmonizing these activities with wildlife interests, to conserving marsh and aquatic habitats, and to devising means that would permit mosquito control where needed and at the same time save wildlife habitat. The destructive effects have been due chiefly to fluctuation of water levels beyond the limits the most desirable plants can tolerate, and so lowering the water levels as to expose wigeongrass, sago pondweed, and other submerged plants to the direct rays of the sun and consequently to kill them. In such areas other marsh plants usually utterly useless or of less food value invade the land. Recommendations have been made that, where possible, water levels be controlled through the use of sluices, flood gates, or head gates, or by other means.

CHESAPEAKE AND ALBEMARLE CANAL LOCK

The experimental opening of the lock in the Chesapeake and Albemarle Canal, at Great Bridge, Va., permitted resumption of the flow, once checked, of polluted saline waters from Norfolk harbor into Currituck Sound, N. C., and Back Bay, Va. Investigations disclosed the fact that the progressive improvement of aquatic plants following reestablishment of the lock in 1932 had been overcome, and that conditions for waterfowl had grown steadily worse. On the basis of the Bureau's findings, which were presented at a public hearing in Norfolk on June 21, 1935, the War Department decided to maintain the lock in normal operation as a guard against further pollution.

WATERFOWL FOOD CONDITIONS ELSEWHERE

Investigations were continued to determine precise water conditions with reference to salinity, alkalinity, and acidity associated with the growth of certain important waterfowl food plants. Studies were made in the sand-hill section of Nebraska, the Panhandle of Texas, and in North Carolina, Washington, and Oregon.

Studies also were made of eelgrass, formerly the principal food of sea brant and an important food of other waterfowl along the Atlantic coast. Reliable information was obtained regarding the situation and made public in a mimeographed leaflet of the Bureau (BS–3) under the title "The Present Situation Regarding Eelgrass, *Zostera marina*."

During the year biological surveys were made of proposed waterfowl-refuge areas with respect to their food resources, availability of food and cover, water conditions, and general suitability, in every State except Michigan, Kentucky, Wisconsin, and Utah. Reports were submitted and recommendations made for improving conditions where necessary.

CONTROL OF UNDESIRABLE WATER PLANTS

The rapid spread of the introduced water caltrop (*Trapa natans*) in the Potomac River has been the cause of deep concern. In some places the plant has increased to such an extent as to hinder navigation and has smothered out many acres of valuable wild-fowl food plants. It was recommended that the plant be eliminated as speedily as possible. Funds and labor were made available through the Civilian Conservation Corps and the Division of National Capital Parks of the National Park Service to construct a fleet of flat-bottomed boats and to design an aquatic mower. Experiments with chemical sprays and mechanical methods, begun last summer, were continued during the growing season. The Bureau recommended that work should be undertaken, beginning at Washington and proceeding toward the mouth of the river, to eradicate the plant completely. Members of the New York Conservation Commission have consulted with Bureau specialists concerning the possibility of eradicating water caltrop from the Schenectady area also.

The course run by water caltrop from adventitious introduction to the status of a serious pest should be considered when any aquatic plant of negative value as a wild-fowl food is observed in a new area. Such new aquatic or marsh plants should be immediately appraised and, if extirpation is decreed, drastic action should be taken. An illustration is the recent discovery in the Potomac at Washington by a member of the Bureau's staff of a small stand of giant cutgrass, or southern wildrice (*Zizaniopsis miliacea*), a plant that affords a minimum of food and only fair cover for wild fowl, and, where it makes a stand, inevitably replaces wildrice and other more valuable waterfowl food plants. Steps were taken to eliminate the entire patch of this possible pest the day after it was observed.

LABORATORY WORK ON FOOD HABITS OF WILDLIFE

STOMACH ANALYSES ACCOMPLISHED

The work of stomach-content examination, which forms the basis for much of the economic work of the Bureau, suffered materially by the necessity of diverting trained men to field surveys of proposed refuge sites and to studies of waterfowl breeding and feeding grounds. Stomach analyses in the Washington laboratory, however, included those of 806 birds, 197 mammals, and 3 reptiles, in addition to identification of the contents of 156 owl pellets. In

the Food Habits Research Laboratory at Denver, Colo., 11 pellets of white-necked ravens and 83 fecal samples of the coyote were analyzed, in addition to contents of the stomachs of 337 birds, including 90 white-necked ravens and 103 crows, and stomachs of 4,561 mammals, including 3,680 coyotes and 613 bobcats.

Examination of the stomach contents of all diving ducks on hand has been completed, and the work of tabulating the information on their economic relationships is in progress, preparatory to publication. Statistical compilations have been completed for a report on fish-eating birds, the first section of which, concerning the herons, is now being prepared for publication. A manuscript for a technical bulletin on the food habits of the woodcock, snipe, dowitcher, and knot was brought to date through the examination of additional stomach material.

The stomach contents of 50 woodcock and 38 tree sparrows were determined for monographic studies being made on these birds. Besides these, numerous other minor examinations for outside agencies were made. Several stomach examinations and identifications of fur and flesh were made in connection with State and Federal game-law violations. In connection with a legal process in Louisiana, it was necessary to examine 24 stomachs of the blue goose and to tabulate the food of 18 species of ducks, geese, rails, and shore birds. Laboratory experiments were undertaken to determine the relationship, if any, between lead-shot poisoning and the quantity of grit in waterfowl stomachs.

ECONOMIC STUDIES REPORTED ON

An economic study, The Crested Myna, or Chinese Starling, in the Pacific Northwest (Tech. Bull. 467), was published in April, with the recommendation that the bird should be discouraged from coming into the United States from British Columbia, where it is now established. It appears to have more objectionable habits than its close relative, the European starling, and serious economic consequences are anticipated if it should be permitted to become established in fruit-growing sections of the West.

A publication (Circ. No. 348) containing discussion of the food value, together with descriptions and illustrations of the quail-food plants of the Southeastern States, was published for the guidance of persons wishing to improve environments for bobwhite quail.

Continuing a study requested by the American Society of Mammalogists, there was prepared and published in the Journal of Mammalogy for November 1934 an article, Winter Food Habits of the Coyotes: a Report of Progress, 1933, and a manuscript was prepared on the fall-winter food habits of coyotes. Sufficient material to permit the completion of reports on the spring and summer food habits of the species is now available.

The work on the collection of mammalian hair, which has continued most successfully, was reported upon in an article, A Simple Method for Sectioning Mammalian Hairs for Identification Purposes, published in the August 1934 issue of the Journal of Mammalogy. One of the most interesting cooperative tasks of the year was the identification for the Museum of Northern Arizona of rabbit fur taken from the 1,500-year-old grave of a Basket Maker Indian. Another interesting examination was that of intestinal material of a mummy taken from a cave in Arkansas, in an effort to learn something of the food habits of early aborigines of this continent.

In cooperation with the conservation department of New York, the stomachs and crops of 80 ruffed grouse were examined and the findings embodied in a mimeographed leaflet (BS–1) entitled "Winter Food of the Ruffed Grouse in New York", initiating a Bureau series of wildlife research and management leaflets to present current information as developed. Another leaflet in this series (BS–11), based on stomach analyses of various species, was issued under the title "Birds Aid Blueberry and Cranberry Growers."

COOPERATIVE INVESTIGATIONS

Economic studies of predatory animals and birds in Virginia, Michigan, Texas, and Colorado were carried on as a part of a general cooperative program. Assistance was rendered the University of Wyoming in outlining a detailed life-history and game-management study of the sage hen and in examining the crops and gizzards of 33 birds. Knowledge of the food habits of the scaled quail has been advanced during the year by analyses of 128 stomachs, 14 of

these for the southwestern game-management project. In cooperation with the Virginia Commission of Game and Inland Fisheries, the stomachs of 45 gray and 2 red foxes were examined; as also were those of 1 gray fox, 13 red foxes, 48 coyotes, and 7 bobcats for the Michigan Department of Conservation. The contents of 83 fecal masses of coyotes were identified for the National Park Service. For the Hawk and Owl Society, 100 pellets of the barred owl were examined; and 40 of the short-eared owl for the Texas Christian University.

PRACTICAL IMPORTANCE OF LABORATORY WORK

Lists of foods thought by field observers to be important for upland-game birds were submitted with two series of crops and stomachs collected in different localities. After the material had been examined the lists of actual foods, in order of preference, were compared with lists made in the field. The results are worthy of serious consideration when recommendations for upland-game-bird foods for one section are made upon the basis of food eaten in another, though neighboring. It was found that about half the plant foods listed in the field as important did not form an important article in the diet, while less than half the foods that were important had been listed in the field and many of the major food items had been overlooked there. These studies confirm the stated policy of the Bureau, that specific economic status must be determined individually for each region concerned and at different seasons and under varying conditions, rather than depending upon generalizations for the whole country, on the basis of limited local material. They show also how indispensable laboratory stomach analyses are as a supplement to field studies and confirm the conclusion that in determining food preferences for most species, laboratory examinations are more accurate than field observations. A comprehensive statement on the value of research into the food habits of wildlife was published in the hearings on the agricultural appropriation bill for 1936 (pp. 717–737) and reprinted for distribution by the Bureau.

FOOD OF UPLAND GAME

A survey of wildlife food and cover conditions on the Norris Dam area was made for the Tennessee Valley Authority, to which agency a report was submitted, including lists of desirable game-food plants, suggestions on propagation methods, and lists of sources for restocking with wildlife. A survey of the available game foods in State forests of Tennessee also was undertaken at the request of the State forester, and recommendations were made for improvement of the food supply. The Survey has continued as a cooperator in the series of experimental upland-game-bird projects initiated several years ago in Arkansas, Oklahoma, Indiana, and South Carolina. From these it has obtained valuable information on management practices relating to quail and lesser prairie chickens.

Various upland-game-management projects have been furthered through cooperation with individuals, universities, State game commissions, and other institutions by laboratory examination of crop and stomach contents of birds or mammals and by identification of the specific food items submitted. The stomachs of 15 elk and 48 deer from two western parks were examined at the request of the National Park Service, and 18 stomachs of upland-game birds were analyzed for the Soil Conservation Service in connection with studies to gather information for the correlation of soil-conservation practices and game management.

A catalog of trees and shrubs useful to wildlife as food and cover and suitable for planting in each of the States included in the Great Plains shelterbelt was prepared and submitted to the Forest Service.

RELATIONSHIPS OF PREDATORS AND UPLAND GAME BIRDS

During May and June a field investigation was carried on in Virginia to determine the extent of fox depredations upon nesting game birds, during which 35 ruffed grouse and 78 bobwhite quail nests along with 20 fox dens were kept under observation. The extent to which foxes destroy game-bird nests has been much in dispute.

Observation of the biological relationship between predators, bobwhite quail, and rodents on a Virginia game farm was continued. Examination of 46 predator stomachs indicated that the foxes, house cats, and birds of prey were

taking meadow mice almost exclusively. These rodents had become unduly abundant on the area as a result of improved food and cover conditions incident to game-management practices. A survey was made of five Texas sheep ranches enclosed for periods varying from 5 to 15 years by coyote-proof fences. Even in these areas the bobwhite quail had decreased because of the scarcity of nesting cover coincident with overgrazing.

FIELD STUDIES OF INJURIOUS BIRDS

There is a constant need for research in bird control and for developing methods to make it less necessary to destroy bird life. Selective and specific measures for control are an urgent necessity, and considerable time has been devoted to a solution of important control problems.

CROW-DUCK RELATIONSHIPS

The field investigation of crows in relation to nesting waterfowl, carried on in the Prairie Provinces of Canada in the summer of 1934, was resumed in May 1935. When the work in Saskatchewan for 1934 was completed it was found that approximately a third of all duck nests under observation on a single marsh had been destroyed by crows. Because of peculiar local conditions and an unusual concentration of the nesting birds there, another representative area in the vicinity of Cooking Lake, Alberta, was selected for the 1935 season's work. Though nesting histories are incomplete, the data indicate that a large number of eggs were pilfered by crows. With the present reduced duck population it appears that effective control of crows during the breeding season will be necessary on many waterfowl-nesting areas. Laboratory studies of the stomachs of crows collected on the Cooking Lake area indicated that 4 percent of the diet of the adults and 10 percent of that of the nestlings consisted of bird and egg material. Correlated with these findings was the observation that again approximately a third of the duck nests in the vicinity had been destroyed. This information may prove to be an important index to interpreting the degree of depredation by crows in any given area, as determined by stomach examination. Experimental work on crow control was carried on in Alberta, and also in Oklahoma for 1 month in winter. Particular attention was paid in the winter study to bombing, trapping, and the development of a selective poison.

WHITE-NECKED RAVEN CONTROL

The control of the white-necked raven was advanced by field experimentation involving trapping and baiting and by laboratory study to determine food preferences. Information on the life history of these birds was collected, and the nature and extent of their depredations on peanut, melon, and pecan crops in Texas and New Mexico were ascertained. The results have been incorporated in a manuscript to be issued as a mimeographed leaflet describing a cage trap.

WATERFOWL DEPREDATIONS

Wild ducks were accused of causing injury to various interests both in the East and in the West. Investigation of complaints by fishermen in Massachusetts that eider ducks were feeding heavily on scallops showed that these birds, though feeding over the scallop beds, were actually utilizing noncommercial shellfish, but that white-winged scoters were feeding on scallops and other commercial forms. Because of these findings regulations were adjusted so as to reduce destruction of the eider ducks.

On Long Island, N. Y., after the open season, the discontinuance of baiting during an exceptionally severe winter forced many black ducks to find food in strange places, even in chicken yards and at fish ponds. Black ducks gaining access to a trout hatchery through a hole in the protective netting ate practically an entire trout crop, consisting of about 20,000 small fish. Complaints of duck and goose damage to grain crops in various sections may also be considered an aftermath of baiting.

Investigations were made to devise means of frightening waterfowl from crops without injury to the birds. These studies have resulted in the preparation of a leaflet on the relationship of waterfowl to crops, including recommendations for reducing both crop damage and destruction of birds.

HERON DEPREDATIONS

Black-crowned night herons have afforded a frequent source of complaint, not only because of their fish-eating propensities and predatory relationships to other forms of wildlife, but also because of their habit of colonizing in close proximity to houses. Two complaints against these birds, one in Massachusetts and the other in New York, were not sustained upon investigation, while limited control was approved in one instance on Long Island. Investigation of a complaint that these herons were destroying duck nests in the Lake Erie marshes exonerated them and fixed the blame upon skunks, crows, and house rats. Prompt and simple remedial measures prevented further losses and needless destruction of the herons. Depredations of "bitterns" at a fish hatchery in Nebraska proved to be largely the work of immature black-crowned night herons. The recommendations made by trained field men when compared with the action requested by the complainants confirm the wisdom of the policy of having Bureau representatives investigate reports of depredations whenever feasible, and devise methods for preventing losses.

BIRD DEPREDATIONS IN CALIFORNIA

The need for studies of the control of injurious birds in California continues, though the species causing the most damage may vary both locally and seasonally. Linnets and horned larks still occasion much injury to fruits, truck crops, and seedlings. The horned lark was the subject of considerable study in cooperation with county agricultural commissions to develop baiting methods for selective control. Wherever possible preventive rather than control measures were applied. This year blackbirds receded from the place of prime importance in the depredation picture. The crow, however, was responsible for considerable losses in almond groves, and English sparrows as well as native sparrows of the "crowned" group (*Zonotrichia*) caused significant damage by pulling up or devouring seedlings.

RESEARCH IN FUR PRODUCTION

FUR ANIMALS IN THE LAND PROGRAM

Fur animals, one of the most valuable natural resources of this country and one of the most sadly neglected and atrociously wasted, must have consideration in establishing policies for land mangagement. The annual turn-over in the retail fur trade has shrunk from $500,000,000 in 1929 to $150,000,000 for the past year. The information collected shows that this shrinkage cannot be attributed wholly to drought, floods, and the financial depression, but that it results in part from an actual scarcity of fur animals. To what extent this is due to overtrapping and failure to preserve natural habitat is not definitely known. Information is not available to show whether 10,000,000 or 15,000,000 muskrats are being produced while 13,000,000 are being trapped, and yet under a good business management of fur bearers the first thing to be determined is the number of the different species produced and killed annually on such areas as remain available. The Bureau has encouraged State game agencies issuing trapping licenses to obtain laws requiring reports of trappers, so that the individual States might calculate the numbers and kinds of their fur animals taken annually. This would make reliable estimates possible on the total annual take in the whole country. At present 7 States require trappers to report their catch and 19 compile data from various sources. Definite and practical policies of management, involving the preservation of hereditary habitat, must be established to insure a permanent supply of fur animals.

The Bureau has continued to compile such data as are available on the number of trappers and the number of fur animals taken in the various States. To assist in arousing a public sentiment to care properly for the valuable natural resources represented by fur bearers, the Bureau has issued a mimeographed abstract of State laws on trapping seasons. It has also encouraged the movement inaugurated by a few States for the issuance of separate hunting and trapping licenses to replace the combination trapping, hunting, and fishing licenses, so that funds accruing from hunting and trapping may be expended to develop the resource from which derived and the preservation of breeding grounds. Such funds would assist in developing and managing the fur resources on a sustained-yield basis.

Investigations show that many swamps and marshes are havens for muskrats and other fur animals as well as for migratory waterfowl. Some tidal

and inland marsh areas are capable of producing in addition to other wildlife five muskrats to the acre, sometimes more. At present market prices, muskrat pelts alone may yield $7 to $14 an acre each season. Such land should be left undrained, as no other system of cropping would produce as much as can be realized in direct and indirect returns from the wildlife. The large majority of trappers are farm boys and farmers. The employment thus furnished and the income supplied to the rural population are sufficient justification for arousing public sentiment to save what is still left of our fur resources and their habitat, and to build up the supply on a sound business footing. The fur trade has been encouraged to cooperate with local, State, and Federal agencies in fostering constructive policies, so that fur animals may be conserved rather than ruthlessly exploited. The Bureau's warnings on fur depredation in the wild were epitomized in a short article in the 1935 Yearbook of Agriculture (pp. 218–220), under the title "Fur Scarcity Through Overtrapping Impends; Conservation Needed."

PROGRESS IN FUR FARMING

Raising fur animals is an important and profitable farm operation, not only in supplementing the natural supply but also in using land of little value for crops. No branch of animal production has developed more rapidly during the depression or resulted in greater profits than silver fox farming, and this at a time when some farm commodities scarcely had a market. The investment in fur farming is now estimated at $50,000,000. Fox farmers in 1934–35 harvested 170,000 pelts, having a total value of approximately $7,000,000. They have demonstrated their ability to repay Federal loans made upon the Farm Credit Administration's approval of silver foxes as eligible security. Commercial concerns that advanced feed to fox farmers on such credit report practically no financial losses therefrom.

Fur farming is now established in 35 States and is not in competition with any other type of farming. The industry is organized, with 3 national, 15 regional, and 16 State associations. A list of these was published during the year in a Bureau mimeographed leaflet (Bi–1357).

THE PROBLEM OF TINGE

During recent years the quantities of tinged, or brown-colored, fox pelts have increased to an extent to cause concern among fox farmers and fur tradesmen. Research is the only means of discovering the causes involved. As foxes are raised primarily for their pelts, the quality of fur must be given first consideration, and other things being equal, the clear-colored pelts bring the best prices. All the silver fox pelts produced at the United States Fur Animal Experiment Station are being graded and appraised by the most competent judges in the fur trade, in order to obtain definite information on skins produced under controlled conditions and from animals whose breeding is known, and to learn the importance of several possible causes of tinge, including heredity, feed, sunlight, climate, and methods of handling. Continued tests at the station show that the use of furring sheds is an important means in controlling tinge, especially under the practice of placing the foxes in these sheds 5 to 6 months before pelting.

SURVEY OF THE FUR INDUSTRY

A comprehensive survey of the fur industry of the United States is being made by the Hudson's Bay Co., which has been engaged in the fur business for more than 250 years. In the absence of a central organization of the fur trade from which to obtain statistical data, the company turned to this Bureau for assistance. All available information was given, and in return the company will supply the Bureau with a copy of its report.

FUR ANIMAL EXPERIMENT STATION

FEEDING EXPERIMENTS

Experimental work designed to aid fur farmers to reduce costs of feeding, breeding, and general management is of vital importance to the industry. Experiments with substitutes for raw meat in rations have been continued at the United States Fur Animal Experiment Station, at Saratoga Springs, N. Y. This research is now of exceptional importance because of the rise in meat prices. Ordinarily 40 to 60 percent of the ration fed to foxes is composed of meat and meat byproducts, and increased cost of feed is a practical

concern to fur farmers because of its effect on production costs. There was a considerable saving in the cost of feed when 5 parts of dehydrated beef meal and 1 part of liver meal were substituted for the raw-meat portion of the ration for lactating vixens and for pups. There was no difference in the number of vixens that whelped young or in the size of litters in two test groups of foxes. Those receiving the substitute seemed to have no milk at the end of 6 weeks of the suckling period, while those receiving meat had a normal secretion during the entire suckling period of 8 weeks. Weaned pups fed the same rations showed no appreciable difference in growth, quality of fur, or general health. A slight difference was noted in food consumption and growth in favor of the meat ration, but it cost almost twice as much to feed a pup the meat ration as the substitute.

An experiment to determine the value of digester tankage, a common and easily procurable packing-house byproduct, in conjunction with liver meal as a substitute for the raw-meat portion of the ration is now under way. Meat scraps, or meat and bone scraps, also will be tested to determine their value as a substitute for raw meat. The experiments have been planned to include feeding tests during breeding, gestation, and lactation periods of vixens, the summer maintenance period for mature foxes, and the developing period for pups. Attempt also has been made to find suitable readily procurable cereals or cereal products both cooked and uncooked that can satisfactorily replace the constantly diminishing byproducts formerly obtained from breakfast-food manufacturers.

Experiments were undertaken near the close of the fiscal year to determine the value of various meat substitutes also in feeding mature and young minks.

FOX-BREEDING EXPERIMENTS

In recent years with the popular demand shifting from the darker silver fox pelts to those classed as three-fourths and full silvers the trend has been to select the more lightly silvered foxes as breeders. To meet the constantly shifting market demands as to the degree of silvering in fox pelts it is important to determine the genetic basis of silvering. A breeding experiment was begun this year to isolate the genetic factors so that market requirements might be met promptly.

To supplement this experiment data are being compiled on the number of silver-fox pelts produced annually in the United States, and more particularly on the relative percentage of pelts falling in the various degrees of silver. This will afford opportunity to follow the trend of the market more closely and to keep fur farmers informed of the progress being made in methods of meeting changing demands. An article on the use of elevated wire floors as a practical means to prevent lungworm infestation of foxes was prepared and published in the Journal of the American Veterinary Medical Association, in April 1935.

RABBIT EXPERIMENT STATION

FEEDING AND BREEDING STUDIES

Experimental work conducted at the United States Rabbit Experiment Station at Fontana, Calif., has been designed to improve feeding and management practices in commercial rabbitries. Feeding experiments were concerned with factors affecting molt and rate of hair growth; economical production of fryer rabbits; and the value of succulent feed, salt, and cod-liver oil as constituents in the rations.

In a definite breeding program pursued for selecting and reproducing rabbits possessing superior germ plasm, some exceptional results have been obtained. Eighty-nine pounds of marketable rabbits, averaging in weight 4.46 pounds at 8 weeks of age, were developed from three litters of a single doe, in the 234 days from the breeding date of the first litter to the weaning of the third.

Four experiments conducted on rations over a period of 2 years were completed, the first designed to learn the effect of varying quantities of protein on the production of does; the second to determine the relative feeding value of oats, barley, wheat, and corn; the third to compare a method of feeding mash and hay with that of a complete ration in pellet form for developing does; the fourth to determine feed consumption and cost of 13 different rations. Carcass values, distribution of commercial cuts, and value of fur according to age, season, and breeding were other factors considered in this experiment. Data were obtained on 700 rabbits slaughtered at 6 pounds live weight. The pelts,

both in the raw state and after they were dressed and dyed, were graded and appraised by experts in the trade. Progress reports were furnished rabbit breeders, fur tradesmen, and others desiring this type of information. An exhibit at the Los Angeles County Fair, demonstrating the work of the station and more particularly the nutritional value of rabbit meat, was favorably commented upon in the press and in rabbit periodicals published in the United States and abroad. A new Farmers' Bulletin (no. 1730), Rabbit Production, was issued during the year.

SELF-FEEDER EXPERIMENTS

A self-feeder suitable for rabbits has been developed at the Rabbit Experiment Station, and approximately 100 are being used in experimental feeding to improve certain details, preparatory to recommending it for general use in the industry. The rabbit seems to have ability to balance its own ration if allowed to select from the proper kinds of feed. Most encouraging results have been obtained, and it is believed that the self-feeder will assist materially in determining the proper proportions of grain and roughage, the most desirable nutritive ratio, and the kinds of feed best suited for use during the gestation, lactation, and maintenance periods. The basic data being accumulated will serve for developing a feeding standard for rabbits comparable with those already formulated for various kinds of livestock. As rabbits will not readily consume finely ground feeds, plant-protein supplements, such as peanut, cottonseed, linseed, sesame, and soybean meals, have been adapted to self-feeding by molding into pellets three-sixteenths of an inch in diameter and one-eighth of an inch long without addition of moisture. The rabbits showed little preference for any one of these meals when it was ground to the same degree of fineness, but when fed in the form of pellets to 150 rabbits of various ages over a long period, the peanut-meal pellets were found to be by far the most acceptable; sesame was second choice; and no great preference was indicated among cottonseed, linseed, and soybean pellets.

FACTORS INFLUENCING "BLOAT"

"Bloat" continues to be a serious concern of commercial rabbit raisers, some producers reporting losses as high as 72 percent in young rabbits. Previous experimental work at the Fontana station has indicated that bloat is neither infectious nor contagious. Feeding tests with California alfalfa hay cured and baled under careful supervision, with alfalfa hay shipped from the Midwest, and with Sudan grass hay indicate that the roughage portion from the ration is not the major cause of bloat. At present the form in which the grain is fed—that is, whole, rolled, or soaked—and the possibility of an iron deficiency as a contributing cause are receiving particular study.

FUR INVESTIGATIONS ON BIRD REFUGES

A number of refuge areas acquired primarily for conserving migratory waterfowl provide excellent fur-animal habitat, and under proper management can increase fur production with little expenditure of public funds. Crescent Lake Migratory Bird Refuge, Nebr., has furnished for study a complete series of muskrat pelts over a 2-year period. Studies of morphological and physiological factors have been undertaken with muskrat pelts from this and from a number of other refuges, to establish the prime-fur period, and a report on the findings will be prepared for publication. Efforts will be made to broaden this field of research on refuges where fur animals are considered an important resource.

COOPERATIVE STUDIES

KARAKUL-FUR INVESTIGATIONS

The general character of Karakul lambs produced during the past year in cooperative experiments with the Bureau of Animal Industry, at Beltsville, Md., shows considerable improvement, in both quality of fur and conformation. The most desirable purebred ewe lambs are being retained to develop a larger breeding herd. Skins of purebred lambs possess the most desirable luster, curl, and character, and are declared by the fur trade the most valuable, although pelts possessing considerable quality are occasionally produced from crossbred animals. During the year 10 purebred Karakul, 15 Karakul-Highland cross, and 15 Karakul-Corriedale cross lambs, ranging from 1 to 4 days of age, were pelted at Beltsville. The pelts will be carefully inspected and graded, and the information obtained will be useful in selecting breeding animals.

FUR-STORAGE EXPERIMENTS

A cooperative experiment has been continued with local fur-storage concerns and the Bureau of Entomology and Plant Quarantine to determine the relative values of various storage methods and their effects on furs and linings. During the year 20 rabbit skins, dressed and dyed various colors, 4 muskrat (Hudson seal), 8 Russian squirrel, and 3 Persian lambskins were stored, after being marked for identification and cut into halves, thirds, and quarters. Some of these, together with various samples of linings used in fur garments, have been placed in cold-storage and fumigating vaults, and some are being cared for by the old chest-and-moth-ball method. The experiment has now been in progress for 2 years.

EMBRYOLOGICAL STUDIES

During the latter part of the year an embryologist studied the reproductive organs of selected coyotes, wolves, mountain lions, muskrats, and other fur animals, to obtain more definite data on breeding and gestation periods. This information is needed in fur-farming operations and in making recommendations regarding trapping seasons. The study is a cooperative undertaking with the Carnegie Institution of Washington, and the laboratory work is performed at the Johns Hopkins University, Baltimore, Md.

DISEASE-CONTROL INVESTIGATIONS

PERIODIC FLUCTUATIONS OF WILD SPECIES

Investigations have been continued on the nature of the pronounced cyclic disappearance and return to abundance of important game species, which are frequently independent of weather conditions and food supply. When circumstances favor their spread, many infectious diseases are prevalent among these groups and become highly destructive over wide areas. It appears probable that the periodic decimations are due to several factors, among which disease is important.

These studies, carried on largely with the cooperation of the University of Minnesota and the Minnesota Conservation Department, are unique in their plan, in that the relative percentage of infected animals on a given area is computed on the basis of samples collected throughout the year. Careful counts and identifications of parasites are made, and conclusions as to their relationship to the spread of disease are based on the actual isolation of disease germs found both in the parasites collected from animals and those free on vegetation, awaiting opportunity for attachment to a suitable host. The action of parasites in the transmission of disease has long been known, but these studies indicate an intimate relationship between the abundance of certain ectoparasites and the rapid spread of epizootics among wild forms.

The significance of the role of wildlife disease was discussed in two mimeographed leaflets (BS–5 and BS–9, respectively) under the titles, "Tularemia, an Animal-Borne Disease", and "Infectious Disease as a Cause of Loss in Wildlife", and in two articles in the 1935 Yearbook of Agriculture—"Predators and Rodents are Factors in the Spread of Disease" (pp. 284–286) and "Botulism is a Factor in the Decrease of Western Waterfowl" (pp. 140–143).

FUR-ANIMAL LOSSES

Diseases continue to take an important toll not only among animals in the wild but also on fur farms. Through information developed by the Bureau, in cooperation with the University of Minnesota and individual fur ranchers, some infectious diseases known to cause excessive losses are well under control, though other infectious agents not yet under control are found capable of entailing heavy damage. Continued studies correlating losses on fur farms with infections found in wild fur bearers make it apparent that many of the diseases prevalent among ranch-raised stock are brought in from the wild. These diseases are shown to be dissimilar to those occurring among domestic animals.

In efforts to procure a cheaper food supply, many fur farmers have caused digestive irregularities that are difficult to differentiate from infectious diseases. A large proportion of the animals on a ranch are simultaneously affected, and the degenerative changes present in vital organs are confused with similar appearances caused by pathological organisms. Recent investigations indicate that the greater frequency of urinary calculi observed is due to errors in feeding.

Serious losses among foxes, muskrats, raccoons, and other wild fur bearers have been studied. Raccoon losses were traced to an infection with *Pasturella pseudotuberculosis*. Losses among muskrats on some of the most valuable trapping marshes have been found due to the same organism as well as to excessive parasitism. It has been shown that control of the latter condition may be largely effected by maintaining ample water levels on the marshes.

WATER-POLLUTION STUDIES

The possibility of developing more effective restraint on the sources of water pollution and of minimizing its injurious effect upon wildlife has stimulated further research on this subject. It has been found that while much of the chemical waste reaching in and waters can be so treated as to render it relatively innocuous, most industrial-waste products do not kill wild birds and mammals directly, but instead destroy vegetation on which they subsist and thus render large areas of their natural habitat useless.

This is not true of pollution by oil. This substance is released in such quantities in the streams and lakes adjacent to many cities as to be a constant menace to the waterfowl feeding and resting there. It is difficult to impress municipalities with the seriousness of this form of wildlife waste, since the films of oil thus spread upon the waters are so thin as to appear insignificant, and the losses of waterfowl occasioned by them may not be spectacular in any one locality. The total loss throughout the United States, however, is important.

Another form of pollution to which attention has been given is the menace of lead shot in marshes, which when eaten by birds feeding there cause fatal lead poisoning. Comparatively little attention had thus far been given to developing satisfactory control measures, because of inadequate funds, but during the past year the interest of workers of the University of Minnesota has been enlisted, and at present intensive research is in progress in an effort to develop a type of nontoxic shot.

LAND-ACQUISITION SURVEYS AND NEGOTIATIONS

GROUNDWORK AND ACCOMPLISHMENTS

Shortly before the close of the fiscal year 1934, emergency funds aggregating $6,000,000 were allocated to the Biological Survey for the acquisition of migratory-waterfowl refuges, and soon investigations were begun on 15 units. In previous work under the Migratory Bird Conservation Act the Bureau had assembled substantial facts regarding some of these, and it therefore became possible to begin negotiations for acquiring lands known to be desirable. Three outstanding cases were closed: Lake Mattamuskeet in North Carolina, containing 50,000 acres; the initial part of the White River Migratory Waterfowl Refuge in Arkansas, including 45,000 acres; and the Blitzen Valley unit in Oregon, containing 64,720 acres. In addition to these, Goat Island Migratory Bird Refuge, 21 acres off the coast of Oregon, was established by Executive order on May 6, 1935.

Other proposed units called for engineering studies over extensive periods, so that the full impetus of land-acquisition work did not make itself felt until about September 1934. Preliminary work, however, looking to negotiations for hundreds of small tracts within many of the prospective areas was begun with the limited experienced personnel early in the fiscal year and steadily gained in momentum as the force was expanded. By March 31, 36 units had been designated, valuation examinations were mostly completed, and negotiations were well under way for the purchase of the numerous tracts that were finally selected as desirable. By the end of the fiscal year there had been examined and appraised approximately 1,000,000 acres of land; and negotiations for the acquisition of 925,570 acres had been conducted and successfully consummated at an average cost of $8 an acre (including approximately 12 percent of lands taken by judicial proceedings because of inability to reach mutual satisfactory price agreements or by reason of incurable defects in title). Details pertaining to the refuge units acquired and in process of acquisition are set forth under another heading (tables 2 to 5).

PROBLEMS INVOLVED

Some problems in the acquisition of migratory-bird refuges are unique, and many are more than ordinarily difficult. It is imperative that all lands within a given administrative unit be owned in their entirety by the United States

so that the refuge may be administered effectively. The waterfowl to be protected move from place to place, so that any lands in alien ownership intermingled with Government-owned lands would not only interfere with development plans but would make effective protection of the birds impossible.

Prior to negotiations, all lands considered for acquisition were examined in detail by precise methods to classify them as to physical features, uses being made of them, crop-production capacity, and existing improvements. Great diversity of land-use types was found, 18 percent being devoted to grain-crop production, 11 percent to the production of hay, 30 percent to grazing, 20 percent to timber production, and 13 percent was marsh. In addition, the exterior limits of the units acquired contained a large percentage of natural water areas. The grain-crop lands are principally used for wheat production; other crops raised are corn, barley, rye, rice, and cotton. Certain units were primarily valuable because of their capacity for producing muskrats and other fur-bearing animals of importance but of relatively less economic value.

The revenue-producing capacity of the tracts, and thus their market value, was arrived at after exhaustive consideration of the factors involved. Negotiations for the acquisition of the many tracts embraced within the units were not instituted until after field investigations had been completed and a price structure for each land-use type in each unit had been determined and approved. These negotiations were conducted with more than 1,500 individual owners, and in each instance separate valuation determinations were reached for each tract. Many individual ownerships embraced from a few to 5 or 6 types of land; it therefore became necessary to determine the price consideration by finding the average value of all land-use types in each tract and of the improvements.

About 35 percent of the tracts desired were taken under contract with minimum difficulty, and approximately 50 percent involved protracted negotiations; but in about 15 percent price agreements could not be reached. This residue was held by owners unwilling to accept the price offered, or under ownership so involved or complicated that valid options could not be taken from the ostensible owners. It became necessary in such cases to resort to judicial proceedings.

The options for tracts that could be taken by agreement were, as quickly as received, sent to the ultimate approving authority, and after favorable action, title examinations were instituted for conveying the lands to the United States. Concurrently with the title examinations, the Biological Survey undertook cadastral surveys of the lands, to prepare adequate descriptions for use both in the deeds of conveyance and in demarcating the boundaries on the ground, in order to facilitate identity of the lands for administration and trespass-prevention purposes. By the end of the fiscal year, approximately 1,000 miles of boundary lines had been surveyed and the corners permanently monumented with concrete posts capped with bronze tablets suitably marked with Bureau of Biological Survey inscriptions.

The mere acquisition of lands for waterfowl refuges does not automatically reserve them for the purpose. The final step in each project has been the preparation of Executive orders to authorize the Department, through the Bureau of Biological Survey, to administer them as such. Thus to each can be applied all the previously enacted laws for the protection of wildlife and for the administration of such units for that purpose.

A specific formula for conducting land-acquisition negotiations cannot be laid down, and in each instance the method must be left largely to the strategy and good judgment of the negotiators. The problems attached to successful negotiations are numerous. The Biological Survey in dealing with landowners was restricted to the price levels it had established. After a commitment was made for the consummation of individual projects, the situation in each resolved itself into a seller's rather than a buyer's market, thus giving the landowner a decided strategic advantage in all transactions.

At the end of the fiscal year, the Biological Survey had taken under option and commitment 925,570 acres of land in 38 units but the title to all these has not yet been vested in the United States. Executive orders, however, have been prepared for 23 wildlife-refuge units. Fifteen other Executive orders and one proclamation have been prepared covering 5 administrative sites in Alaska and additions to 9 other existing refuges in the United States.

ENGINEERING AND BOUNDARY SURVEYS

Boundary surveys on 20 refuges and engineering surveys and operations for water improvement on others were completed or in progress at the close of the year.

BLACKBEARD ISLAND WILDLIFE REFUGE

With Public Works Administration funds four lakes were created on Blackbeard Island Wildlife Refuge on the coast of Georgia. This was accomplished by driving four artesian wells that develop a flow of 2,400 gallons of water a minute. Earthen dams also have been constructed to retain the water, and suitable spillways to carry off the excess during periods of abnormal precipitation. These improvements make a resting and feeding place of great importance for the Atlantic-coast migrants, in a region otherwise practically destitute of fresh-water attractions.

RAILROAD VALLEY MIGRATORY BIRD REFUGE

Some years previous to the establishment of the Railroad Valley Migratory Bird Refuge in Nevada several artesian wells had been driven on the public domain in this valley in exploring for mineral resources that never materialized. Some water, however, did come to the surface, and this produced several small marsh areas. Appreciating the possibilities of developing the subsurface water resources to the advantage of waterfowl, the Biological Survey, with Public Works Administration funds, made topographic surveys and with these data designed dams and dikes for the impoundment of the existing water supply, and supplemented this with six new wells. The eight ponds thus created now embrace 600 acres, and the number can be substantially increased with larger financial resources. This refuge, in an immense arid region, lies in the direct line of flight of migratory waterfowl. The improvement to food and water resources, while not yet so extensive as desired, will be a valuable contribution to waterfowl conservation.

BIG LAKE BIRD REFUGE

The Big Lake Bird Refuge in Arkansas has for many years been under the administration of the Biological Survey, but instability of the water level, due to drainage enterprises on all sides, has reduced its value as a refuge. The Biological Survey has for a long time recognized the feasibility of correcting this situation, but not until funds were allotted could anything be done about it. During 1934 comprehensive plans were made and contracts let for the construction work to divert water into the refuge by means of canals and the construction of dikes to hold it at desired levels. Rapid progress was being made on this project until stopped by inclement weather last spring. Shortly before the end of July construction work was resumed, and it is anticipated that this project will be finished early in the fiscal year 1936.

CRESCENT LAKE MIGRATORY BIRD REFUGE

Extensive topographical surveys were made on the Crescent Lake Migratory Bird Refuge in Nebraska, and investigations of surface and ground waters were begun. This work is to determine influences affecting changes in the lake areas and to assist in the conservation of the water resources of the refuge. The construction will add about 400 acres to the lake areas.

UPPER MISSISSIPPI RIVER WILDLIFE REFUGE

The purchase of lands within the Upper Mississippi River Wildlife and Fish Refuge, under the provisions of the act that created it, has been brought to a virtual halt for want of funds. Through extensive acquisitions being made by the War Department for the development of the 9-foot channel of the Mississippi River, however, a great part of the lands still in private ownership is being conveyed to the United States, and adjustments satisfactory to both Departments in the matter of administration are being arranged. There will remain remnants of land valuable to wildlife conservation. Though in some instances not necessary to a completely rounded out administrative unit, these should be purchased by the Government as circumstances permit.

BEAR RIVER MIGRATORY BIRD REFUGE

The Bear River Migratory Bird Refuge, Utah, is a functioning unit, but there are still lands within its borders title to which has not been conveyed to the United States. These lands are covered by an exchange agreement with the

owners, the accomplishment of which has been frustrated by difficult complications. The situation, it is hoped, is approaching a satisfactory conclusion through institution of judicial proceedings.

OTHER ACQUISITION WORK

Lack of funds has brought to a halt the acquisition of lands under the provisions of the Migratory Bird Conservation Act, but certain responsibilities under this act continue. Such land-acquisition personnel as could be carried has been used on the waterfowl-restoration program and on acquisitions previously discussed.

THE MIGRATORY WATERFOWL RESTORATION PROGRAM

ESTABLISHMENT OF MIGRATORY WATERFOWL DIVISION

The order reorganizing the Bureau on July 1, 1934, contained the following definition of the scope of the Migratory Waterfowl Division:

> A new division in the United States Bureau of Biological Survey is hereby established, which shall have as its specific responsibility the establishment and maintenance of a National Migratory Waterfowl Program. . . . A careful and thoughtful planning of refuges already owned and those to be acquired during the year and in the future is among the crying needs, both for the efficient functioning of the Bureau in the interests of the migratory birds and in the interests of the public and the sportsmen.
>
> The immediate emergency-acquisition program brought about by allocation of special funds for refuge purposes, drought relief, and submarginal-land retirement will constitute a considerable part of the work of the Bureau in the immediate future. The prospect of an annual fund from the sale of migratory-waterfowl hunting stamps for the purchase and maintenance of refuges requires the preparation of a continuing program. . . .
>
> Plans for a national refuge-acquisition program must be followed by a studied use and maintenance plan for each refuge. A staff of refuge custodians trained in the requirements for adequate maintenance, service, and usage best adapted to the full utilization of the refuge principle must be forthcoming. These objectives will constitute the responsibility of the Division of Migratory Waterfowl.

Upon this new Division fell the immediate responsibility of formulating plans for carrying out the expenditure of a total of $8,500,000 allocated from various emergency funds for relief of drought-stricken and distressed agriculture and the restoration of extensive marsh and drained lake areas for the diminishing species of migratory waterfowl. No such large-scale operations for wildlife had ever before been contemplated in so short a period, nor had funds ever been available for so extensive a restoration program, although for some years the obvious need had been apparent of drastic rehabilitation of nesting grounds if the migratory waterfowl were to maintain a population adequate for even the restricted requirements of the sportsmen.

The President's Committee on Wildlife Restoration had previously brought to national attention the crisis faced by wildlife in general and, more particularly, the crucial fact that without breeding areas restored, there could be no regeneration of the rapidly receding population of migratory waterfowl. That committee's intensive dramatization of the need for wildlife restoration built up a national expectancy. The momentum thus attained, together with the tremendous volume of highly valuable and technical data assembled, became the heritage of the Biological Survey and the groundwork for the operations of the new division.

PERSONNEL PROBLEMS

One of the most serious obstacles to be overcome in instituting the waterfowl program was in the selection of suitable personnel. There was urgent need for trained hydraulic engineers, refuge reconnaissance biologists, and expert land appraisers and negotiators. Although the country was combed, it was difficult to get the handful necessary to start operations.

The lack of available technical men in hydraulic-engineering circles experienced at the outset was overcome through the cooperation of the Bureau of Agricultural Engineering, by which a skeleton force was found. So great was the stringency for trained instrument men, engineering aides, and others, that in the early stages of the program it was actually necessary to train this type of personnel. All engineering surveys and specifications were made and drawn up by the Bureau of Agricultural Engineering. That Bureau also examined and in most instances made topographic surveys and engineering estimates on a total of 54 major projects. In addition to this, it compiled voluminous data regarding watersheds, run-offs, artesian reservoirs, and kindred subjects pertaining to the water supply of the projects. The ability of the

Bureau of Agricultural Engineering to take over so large an assignment on short notice and its cooperation in these respects, were indispensable, and were tantamount to the successful institution of the program.

THE REFUGE CONCEPT

In the initial stages, difficulty was experienced by the variation of the refuge concept in the mind of the interested public. Considerable work was done in combating various militant interests and educating them to the real purpose of a migratory-waterfowl refuge. This included the issuance in November of a circular (No. 339), A Program of Waterfowl Restoration, and publication in the 1935 Yearbook of Agriculture (pp. 330–331) of an article entitled "Waterfowl-Restoration Program Undertaken by the Government."

Migratory-waterfowl refuges are premised on the fact that although the main purpose is to maintain and produce game birds, each refuge will still present numerous utilization opportunities that have direct public benefits. Though it is planned to give the birds on all waterfowl refuges the requisite isolation and security, a large measure of social utilization of these areas is contemplated. Deep-water parts of the great storage reservoirs and adjacent beaches that are of limited use to waterfowl will be given over to public bathing, picnicking, and boating, and in almost all instances the refuges will supply fishing in sections where otherwise there would be practically no opportunities for this sport. The line of demarcation of the various uses, however, has been sharply drawn.

TYPES OF REFUGES CONTEMPLATED

It was early recognized that the national and continental aspects of the migratory-waterfowl situation necessitated the establishment within the United States of three types of refuges: (1) Great nesting restorations in the northwestern breeding grounds; (2) intermediate resting and feeding refuges along the four great waterfowl flyways; and (3) large sections of the few remaining primitive marsh areas along the Gulf coast and in the southwestern border States, together with similar wintering areas on the Atlantic and Pacific coasts.

Because of the previous 6 years of drought conditions in the heart of the breeding grounds, because of the diminishing supply of birds in spite of heavy restrictions on bag limits and open seasons, and because of the almost total lack of breeding refuges of a national character, it was decided to begin the restoration program in the hereditary nesting range of the migratory waterfowl in the Northwest. This attack on the waterfowl problem has been found amply justified after 1 year's restoration activities by the preliminary indications of improvement noted in the great breeding areas within the United States during the 1935 nesting season.

CONSULTING AND COOPERATING AGENCIES

Among the agencies more or less concerned in the institution of the waterfowl program were, in addition to the Bureau of Agricultural Engineering, already mentioned, the following: The Submarginal Land Program of the Federal Emergency Relief Administration; the Resettlement Administration; the War Department (Corps of Engineers); National Resources Board; Forest Service; Bureau of Indian Affairs; Reclamation Service; Bureau of Entomology and Plant Quarantine; Public Health Service; Bureau of Fisheries; State planning boards; State conservation departments; State agricultural colleges and universities; many conservation societies, leagues, and associations; irrigation districts; water users' associations; and private commercial companies or organizations.

In many instances the conflicting interests of one or more of these agencies were successfully mediated by the Biological Survey, or the waterfowl project was either enlarged or modified to give additional benefits to the State, the local people, or the agency particularly concerned. In many cases, the priority interests of an operating agency dictated a modification of the waterfowl plans so as not to injure or negate the activities of other agencies. In all instances, a harmonious and practical solution was found.

Contributory to the general migratory-waterfowl and wildlife program of restoration were the cooperation agreements with various agencies of the Government, arrived at through mutual understandings for more consistent operations in conservation. In fact, this year saw a quickening interest in wildlife problems in all Government agencies having large-scale field operations, including the Indian, Forest, and Reclamation Services.

One of the most encouraging instances of this sort was manifested by the Reclamation Service, which pledged its cooperation in the great task of biologically rehabilitating the large reservoirs of the West, which because of the drainage of many large areas of formerly ideal waterfowl marsh habitat, have grown to have a tremendous waterfowl importance. These reservoirs had been made wildlife refuges by Executive order, under the provisions of which bird protection is made secondary to their primary reclamation uses. It is possible, however, greatly to improve their value for wildlife by a few simple measures, such as fencing breeding grounds against their complete destruction by grazing stock, burning the tules at the right time of year, retaining a minimal water supply, and perpetuating all irrigation-project sumps for the needs of wild fowl. The Reclamation Service has indicated a growing interest in this type of conservation cooperation, and will now actively assist the Biological Survey in achieving these ends.

FIRST YEAR'S ACCOMPLISHMENTS

The end of the fiscal year registered the accomplishment of restoration projects on 19 major refuges and 13 secondary areas and nesting grounds. Among the outstanding projects, some of which are already functioning as restored nesting areas and refuges, are Lake Malheur and the Blitzen River, in southern Oregon; Lake Mattamuskeet, in North Carolina; the Mouse River section of North Dakota; Valentine Lakes, in Nebraska; and the Medicine and Bowdoin Lakes, in Montana. The States of South Dakota, Minnesota, Michigan, Wisconsin, Illinois, Missouri, Arkansas, and California have each their quota of greater or lesser projects, according to the availability of immediately restorable waterfowl areas; and no major flyway of the migratory birds was neglected in negotiating purchases of areas conspicuously contributing to the restoration program. Numerous refuges previously purchased but neglected for want of funds were put into the program, and rehabilitation was accomplished under the emergency employment provisions.

In the course of the year, the field work of eight waterfowl biologists was directed in surveys to determine the suitability of various habitat sites for waterfowl-restoration purposes. These men, working in every State in the Union, inspected and studied 720 tracts, aggregating 8,251,670 acres. The average size of the tracts inspected was 10,716 acres. This gigantic task was necessary not only for the institution and successful prosecution of the year's work, but also as a preliminary step toward the continuing program for the next 2 years, which was made possible by the special appropriation for this purpose in June 1935.

Inasmuch as funds for the acquisition of refuges were not made available until early in July, and because the $2,500,000 construction money would revert to the Treasury after March 31, 1935, land acquisition had to be pushed at a pace that was perhaps too rapid for the most economical operations. Despite this handicap and the great dearth of available trained land examiners and negotiators, 653,000 acres of waterfowl-refuge land were optioned and approved by the Secretary in sufficient time to permit the solicitation prior to March 31 of engineering bids for necessary water impoundment; the letting of contracts totaling $892,181.55 (listed in table 2); and the planning and soliciting of bids for headquarters and administrative developments on the respective refuges, aggregating $440,280 (table 3). Details of headquarters contracts let for 16 refuges and of plans and specifications completed for 10 others are shown in tables 3 and 4.

TABLE 2.—*Water-impoundment contracts let on 653,000 acres of waterfowl refuges prior to Mar. 31, 1935, under allotments expiring on that date, and the amount for each*

Refuge	Amount	Refuge	Amount
Illinois, Chautauqua Bottoms	$78,000.00	North Dakota—Continued.	
Michigan, Seney Marsh	70,574.30	Lower Souris	$146,318.30
Missouri, Squaw Creek	48,338.00	Upper Souris	239,768.14
Montana, Medicine Lake	54,620.25	South Dakota:	
North Dakota:		Lacreek	116,527.86
Arrow-wood	25,600.50	Sand Lake	41,984.00
Des Lacs	70,450.20	Total	892,181.55

TABLE 3.—*Details of contracts let for headquarters and administrative developments on 16 waterfowl refuges*

Refuge	Contract amount	Material and subcontract (60 percent)	Labor				
			Amount (40 percent)	Skilled (40 percent)		Unskilled (60 percent)	
				Hours	Rate	Hours	Rate
Michigan, Seney Marshes	$24,000	$14,000	$10,000	5,714	$0.70	15,000	$0.40
Missouri, Squaw Creek	11,775	7,000	4,775	2,547	.75	6,366	.45
Montana, Medicine Lake	34,972	20,472	14,500	8,286	.70	21,750	.40
North Dakota:							
Arrow-wood	34,484	20,484	14,000	8,000	.70	21,000	.40
Des Lacs	30,783	18,283	12,500	7,143	.70	18,750	.40
Lostwood Lake	12,476	7,000	5,476	3,129	.70	8,214	.40
Lower Souris	34,620	20,620	14,000	8,000	.70	21,000	.40
Upper Souris	16,217	9,716	6,500	3,714	.70	9,750	.40
South Carolina:							
Cape Romain	21,792	12,792	9,000	6,000	.60	21,600	.25
Savannah River	27,473	16,000	11,473	7,648	.60	27,535	.25
South Dakota:							
Lacreek	28,190	16,690	11,500	6,571	.70	17,250	.40
Sand Lake	33,362	19,862	13,500	7,714	.70	20,250	.40
Waubay	14,770	8,770	6,000	3,429	.70	9,000	.40
Tennessee, Lake Isom	11,475	7,000	4,475	2,754	.65	7,671	.35
Utah, Bear River	60,275	35,000	25,275	13,480	.75	33,700	.45
Wisconsin, Trempealeau	29,433	17,433	12,000	6,857	.70	16,000	.45
Contract expansions for outside services (telephone, sewer, water, etc.) for all the above refuges	14,183	8,510	5,673	3,242	.70	8,511	.40
Total	440,280	259,632	180,647	104,228		283,347	

TABLE 4.—*Details of plans and specifications completed at the end of the year for proposals for headquarters developments on 10 waterfowl refuges, additional to contracts listed in table 3*

Refuge	Estimated cost	Material and subcontract (60 percent)	Labor				
			Amount (40 percent)[1]	Skilled (40 percent)		Unskilled (60 percent)	
				Hours	Rate	Hours	Rate
Arkansas, White River	$37,000	$22,000	$15,000	9,231	$0.65	25,714	$0.35
California, Sacramento	33,000	19,500	13,500	7,714	.70	20,250	.40
Illinois, Chautauqua Bottoms	18,000	10,500	7,500	4,000	.75	10,000	.45
Michigan, St. Clair Flats	15,000	9,000	6,000	3,200	.75	8,000	.45
Minnesota:							
Mud Lake	39,000	23,300	15,700	8,373	.75	20,933	.45
Winona (warehouse)	20,000	12,000	8,000	4,571	.70	10,666	.40
Nebraska, Valentine Lakes	40,000	24,000	16,000	8,000	.70	24,000	.40
North Carolina, Lake Mattamuskeet	100,000	60,000	40,000	24,615	.65	80,000	.30
North Dakota, Kenmare (warehouse)	20,000	12,000	8,000	4,571	.70	10,666	.40
Oregon, Lake Malheur	40,000	24,000	16,000	8,666	.75	21,333	.45
Water-supply systems, various refuge headquarters	15,000	10,000	5,000	2,857	.70	7,500	.40
Administrative expense	18,000						
Total	395,000	226,300	150,700	85,798		239,062	

[1] Estimated expenditure per man-year of employment, $1,812.50.

The land required in the institution of this program was examined, appraised, and negotiated for by the Division of Land Acquisition, whose record is elsewhere detailed in this report.

TABLE 5.—*List of migratory-waterfowl refuges consummated during the fiscal year 1935, comprising 31 new refuges obtained with emergency funds, 1 obtained with migratory-bird hunting-stamp funds, and 10 existing refuges rehabilitated*

UNDER EMERGENCY FUNDS

State and refuge	Acreage		Important features
	Planned	Optioned [1]	
Arkansas, White River	110,000	107,968.18	A super refuge protecting one of the greatest winter concentration areas of mallards in the United States.
California, Sacramento	10,880	10,880.00	Great goose wintering area, necessary to save 3 species from extinction.
Illinois, Chautauqua Bottoms.	5,000	4,786.37	A much-needed migration sanctuary in the heart of the Illinois ducking country.
Louisiana:			
Delta	37,000	36,860.97	A great wintering refuge of increasing importance.
Lacassine	30,000	29,814.00	Important unspoiled marsh area for wintering ducks.
Sabine Lake	137,233	137,233.00	Largest tract of unspoiled coastal marsh left available to migratory waterfowl in the United States.
Michigan:			
Lake St. Clair	14,000	14,000.00	An important cooperative undertaking with the Michigan Conservation Department, in an area of heavy migrational concentration.
Seney Marshes	24,630	19,361.62	Restoration of an important black-mallard producing area.
Minnesota:			
Mud Lake	53,000	52,713.00	Restoring an unwise drainage project to a valuable nesting area.
Rice Lake	10,600	10,580.00	Important for nesting facilities, and a valuable flyway resting area.
Missouri:			
Squaw Creek	7,000	6,980.74	Strategic resting point on Missouri River migration route.
Swan Lake	10,000	8,196.26	Important Missouri resting area on Grand River migration route.
Montana:			
Lake Bowdoin	[2] 640	640.00	Most important waterfowl resting lake and attendant breeding ground in Montana.
Medicine Lake	23,700	21,528.00	A superior nesting area in eastern Montana.
Red Rock Lakes	25,000	20,860.00	An excellent duck-nesting area and one of the few remaining nesting places of the trumpeter swan in the United States.
Nebraska, Valentine Lakes.	68,910	67,747.21	A super refuge—the choicest of the sandhill nesting areas.
North Carolina, Lake Mattamuskeet.	50,000	50,000.00	The most important goose and swan wintering area on the Atlantic coast.
North Dakota:			
Arrow-wood	14,000	13,436.68	A nesting-refuge restoration; an extensive public demonstration area.
Des Lacs	15,000	14,059.71	A great nesting and resting place, especially for diving ducks; Northwest field laboratory here.
Lostwood	30,000	23,826.85	A large section of morainal pothole country with almost a dozen permanent lakes and 10,000 nesting potholes.
Lower Souris	50,000	47,026.71	A super refuge—the greatest nesting restoration; planned eventually to produce 1,000,000 ducks annually.
Upper Souris	34,000	29,676.78	Storage dam for both Upper and Lower Souris projects; important flood-control structure and considerable nesting.
Oregon, Lake Malheur and Blitzen Valley.	64,720	64,720.00	A super refuge; restoration of greatest waterfowl area on the Pacific coast.
South Dakota:			
Lacreek	9,362	9,362.06	One of the finest of the nesting-restoration projects.
Lake Andes	365	347.53	An important resting pond in a heavily overshot area.
Sand Lake	20,000	20,303.50	Large-scale nesting-restoration project.
Waubay	2,645	2,117.08	A superior diving-duck nesting area.
Tennessee: Lake Isom	4,200	907.00	Important resting unit adjacent to the Reelfoot Lake concentration area.
Texas, Muleshoe Lakes	5,978	5,811.00	Important sanctuary for great winter concentrations of shoal-water ducks.
Washington, Turnbull.	4,500	2,412.00	Excellent pothole nesting area.
Wisconsin, Trempealeau.	6,112	6,112.00	An extensive public-demonstration waterfowl area.
Total, from emergency funds	878,475	840,268.25	

UNDER FEDERAL MIGRATORY-BIRD HUNTING-STAMP FUNDS [3]

Minnesota, Talcot Lake.	1,029	1,029.00	Nesting and resting refuge; cooperation with Minnesota Conservation Department.

[1] Including acreage committed and title being cleared to the United States.
[2] Remainder public domain, transferred by Reclamation Service.
[3] Stamp funds not available until late in the year.

TABLE 5.—*List of migratory-waterfowl refuges consummated during the fiscal year 1935, comprising 31 new refuges obtained with emergency funds, 1 obtained with migratory-bird hunting-stamp funds, and 10 existing refuges rehabilitated*—Continued

EXISTING REFUGES REHABILITATED

State and refuge	Acreage		Important features
	Planned	Optioned	
Arkansas, Big Lake			Water stabilization and willow clearing ($4,999.95).
Florida, St. Marks	12,000	10,108.00	Purchase of extensive food areas.
Georgia, Savannah River	5,000	4,897.00	Increasing and rounding out acreage; extensive headquarters and fresh-water development.
Maryland, Blackwater			Securing release of agricultural rights ($3,100).
Nebraska:			
Crescent Lake	9,300	4,152.00	Additional water and nesting resources for an already valuable refuge.
Niobrara Refuge	3,400	3,383.11	A waterfowl addition to a big-game refuge.
Nevada, Railroad Valley.			Funds for additional wells and fencing ($4,242.42).
South Carolina:			
Cape Romain	7,700	4,993.00	Rounding out boundaries and purchase of Bull Island to afford fresh water and food.
Savannah River	5,000	2,616.00	Increasing and rounding out acreage; extensive headquarters and fresh-water development.
Utah, Bear River			Extensive headquarters development and reorganization; proposed wild-fowl research center ($70,760).
Total	42,400	30,149.11	

A total of $251,010.93 was spent for gross equipment. This comprised patrol and work boats; headquarters wells and wells for Civilian Conservation Corps camps; water gages; draglines, shovels, scrapers, road rippers, and graders for water-impoundment and embankment work; rock crushers and trail builders for roads and patrol trails; barbed wire for stock-proof fences; levels and transits for survey work; trucks and pick-ups for refuge transportation and development; 100-foot patrol towers; redesigned refuge markers (10-year enamel shields); assorted tools for minor refuge development; tractors, disks, seeders, and mowers for supplementary waterfowl-food raising; fire-fighting equipment; and numerous other instruments and tools indispensable in the development and maintenance of migratory-waterfowl refuges.

INITIAL REFUGE DEVELOPMENT

It should be pointed out that the Bureau cannot assume immediate development of the refuge areas acquired during the year, as it takes from 6 months to a year to complete the transfer of title to the United States, and formal Executive order for the establishment of each refuge is made thereafter. On a number of prospective refuges, however, where reconditioning for waterfowl is most urgent, development has been undertaken through the medium of a license obtained from the individual landowners, giving the Bureau the right to early occupancy and development of the land. Where this has been possible, an extensive development program is already under way, involving further impoundment of water, erection of nesting islands, food plantings, reforestation, reduction and control of fire hazards, building of patrol roads and lanes, erection of patrol towers and stock-proof fencing, control of predators, water-table investigations, sinking of artesian wells, flood irrigation, and many other rehabilitation activities. On one of the refuges thus rehabilitated, more than 500 pairs of nesting birds were counted on 2,000 acres of land in the current breeding season. Complete topographic surveys have been made on most of the refuges in order to expedite future development.

On June 30 there were 22 Civilian Conservation Corps camps at work on migratory-waterfowl projects. This type of development is being rapidly expanded, and application has been made for a $5,500,000 allotment of National Emergency Council funds, which, if granted, will lead to the complete physical and biological rehabilitation of all migratory-bird refuges.

The waterfowl-restoration program is concomitant with a fur-resources restoration, which also is of vital importance. With the exception of the areas saved by the Biological Survey, the entire muskrat population of South Dakota, for example, has been wiped out. From the preserved reservoirs of breeding stock, the State fish and game commission plans to take all excess animals and repopulate thousands of lakes and sloughs, which will be restored during the next wet cycle.

WILDLIFE REFUGE ADMINISTRATION

The Biological Survey is now administering 99 priorly established bird refuges, exclusive of 6 big-game preserves on which birds also are protected. These areas aggregate 1,627,409 acres, exclusive of extensive chains of island refuges in Alaska and Hawaii. Of this area in the United States proper, 767,298 acres are primarily suitable for waterfowl; the remainder, including the various bird rocks, rookeries, and nesting islands in the interior lake regions and along the seacoasts, are principally suitable for nongame birds. Work of the past year in waterfowl restoration will add 32 refuges (table 5), totaling 841,297 acres, to the list of those that are primarily suitable for waterfowl, but will be of service equally well to other species of native local game and other birds. With measures completed for the establishment of 32 additional wildlife refuges during the year, the number now supervised by the Bureau of Biological Survey or in process of establishment is 137.

Much-needed administrative authority and control over the disposition of surplus animals and other products of wildlife refuges was lodged in the Secretary of Agriculture by an act approved June 15, 1935 (Public, No. 148—74th Cong.), which also authorized the distribution of 25 percent of the receipts from such refuges for the benefit of public schools and roads in the county or counties in which located. This provision will afford material relief to local authorities who would suffer loss of revenue by the inclusion of taxable lands in wildlife refuges under the Federal migratory-waterfowl restoration program.

BIRD REFUGES

MALHEUR MIGRATORY WATERFOWL REFUGE

The acquisition of a 64,717-acre tract known as the famous "P Ranch", Harney County, Oreg., an area of historic interest in connection with the early settlement of the section, was completed in March, to be combined with the Lake Malheur Bird Refuge, which adjoins it on the north. The combined areas will be known as the "Malheur Migratory Waterfowl Refuge." In October 1934 opening the gates on the Blitzen River released practically all available stored water, immediately flooding a considerable area within the dry Malheur Lake bed and by the middle of April spreading over 15 sections of it. Late in the spring of 1934 the lake had become dry, the only water entering it coming from one large spring. Because of the extreme drought of last year no waterfowl were on Malheur Lake proper, though a goodly number of ducks and Canada geese were hatched and raised in Blitzen Valley in the general vicinity of the refuge. The partial flooding of Lake Malheur during October attracted myriads of white-fronted, snow, and Canada geese, which fed in the stubble fields and in the shallow water of the lake until it froze over in December. A considerable number of Canada geese and a lesser number of mallards wintered in the open water in favored localities in the valley. In March there was a great migration of snow geese and pintail ducks, but no marked influx of other ducks.

The south side of Malheur Lake was unusually favorable for nesting this year on account of the growth of rank grass and other cover, due to restoration of some water from the Blitzen River and to greater precipitation than at any period in the past 7 years. A large number of Canada geese successfully raised broods there. Twenty-four young geese, hatched at the refuge under domestic hens, were shipped to the Upper Mississippi River Refuge, at Winona, Minn. Owing to inadequate rainfall in the mountains to the north, no water reached Lake Malheur through the channel of Silvies River and no cover or feed for waterfowl was afforded this year on the entire north shore of the lake. Although there was a fair representation of all the species of ducks on the refuge, their numbers were far below those of a few years ago.

Sage hens nested in the vicinity this year, and it is apparent that this species has increased there during the past 3 or 4 years. A considerable number of

mule deer also are living along the Blitzen River within the refuge, and antelope from high plateau lands adjacent to Blitzen Valley come and go at will across the refuge, small bands of from 5 to 15 not being an uncommon sight.

A Civilian Conservation Corps camp established on this area is carrying on a large development program. Work accomplished included the construction of several miles of dyke, a new road, and a site for a look-out tower.

Many visitors come to this refuge to see and study birds and other kinds of wildlife. During the fall, winter, and early spring, 1,597 ducks and coots were banded at the banding trap at the big spring adjacent to the refuge.

The case of the *United States* v. *The State of Oregon*, to determine ownership of lands in the lake bed and vicinity, was decided in favor of the Federal Government in April, and this decision removes many of the obstacles that have prevented necessary control and satisfactory development of the area for waterfowl.

BIG LAKE BIRD REFUGE

High-water conditions on the Big Lake Bird Refuge in Arkansas during the spring were detrimental to the nesting of the wood duck and the hooded merganser, the only species that breed there. A decrease was noted in the numbers of both species this year, and high water was responsible for the presence of egrets and herons also in comparatively small numbers. A goodly number of ducks, however, used the refuge on their southern and northern flights, and during January, February, and March, 7,000 to 8,000 were feeding and resting there, but as high water made feeding conditions unfavorable, many of the birds moved elsewhere.

Under National Industrial Recovery Administration allotments there were completed a new headquarters building, a good motorboat hull, and a 100-foot observation tower. Some 900 acres of small willows were cut away, and many other improvements were effected for water control.

BLACKBEARD ISLAND WILDLIFE REFUGE

An increase in land birds has been noted on the Blackbeard Island Wildlife Refuge in Georgia but during the past three seasons there has been a marked decrease in waterfowl. Pelicans and cormorants also have decreased, but there has been an increase in chachalacas (an introduced tropical bird). Improvement projects necessitating the presence of workmen may have driven some of the birds away, and these activities may also have affected the deer, a number of which have crossed to the adjacent Sapeloe Island. Blackbeard Island has plenty of food for wildlife, and most of the deer observed are in the very best of condition. Approximately 700 wapato plants have been set out for duck food.

Extensive improvements under National Industrial Recovery Administration allotments include a 4-foot trail from one end of the island to the other, erection of a steel observation tower, establishment of telephone connection with the mainland, drilling of 4 wells, from which 3 fresh-water ponds have been produced, and creating another pond from a well at the north end of the island. All the old buildings have been wrecked, and material for a new headquarters has been purchased.

TULE LAKE, CLEAR LAKE, AND UPPER KLAMATH BIRD REFUGES

The Tule and Clear Lakes Refuges in California and the Upper Klamath Bird Refuge in Oregon are administered as a unit. Large numbers of geese and ducks were observed during the migration flights, and many nested on the areas, most of them on Tule Lake. At one time, late in February, 50,000 ducks were seen in flight at Tule Lake, most of them pintails, and there were also goodly numbers of geese. In March, 22,000 lesser snow geese, 10,000 white-fronted, 6,000 cackling, and 2,000 Canada geese were noted in the vicinity of Tule Lake Refuge, also about 30,000 ducks, mostly mallards and pintails. By May 1 all ducks and geese not nesting or crippled left this refuge on their northern flight.

During the fall and winter months, California quail, ring-necked pheasants, and white-crowned sparrows were fed on Tule Lake and vicinity, about 1,000 pounds of wheat having been donated by ranchers for the pheasants. Winter migration flights noted at Upper Klamath Lake included various species of ducks, coots, and swans. A few sick ducks were picked up at this refuge in April.

More than 2,000 muskrats were taken in the Tule Lake Refuge during the fall and spring, indicating the extent to which these animals have increased since the first were seen there in 1931.

In May it was estimated that there were 6,000 birds in the pelican colony at Clear Lake. Six hundred visitors registered at Tule Lake during the year. Predatory animals and birds are numerous on these three refuges so that control measures will have to be undertaken.

BLACKWATER MIGRATORY BIRD REFUGE

Maintenance of a Civilian Conservation Corps camp on the Blackwater Migratory Bird Refuge in Maryland during the greater part of the year somewhat subordinated the regular work to that of the camp program. Artificial feeding of the birds, however, was carried on for about 2½ months when weather conditions permitted. During the spring 45 acres were planted to corn, 30 acres in feed patches to millet, cowpeas, hemp, and lespedeza, and about 10 acres of ponds to sago pondweed and other grasses.

It is estimated that the mallards that nested on the refuge reared 80 to 100 young. An attempt was made to raise young ducks artificially from the eggs of the mallards that frequent the headquarters, the eggs being gathered and set in an incubator. From the 500 eggs thus used only 120 ducks were hatched, the rest proving infertile. The weather was unfavorable, and only 20 ducks were raised.

Improvement work consisted of the construction of truck trails, removal of fire hazards in timberlands, making firebreaks along the boundary lines, and erection of about 5 miles of fence along roads and boundaries to exclude roaming stock and protect planted areas.

CAPE ROMAIN MIGRATORY BIRD REFUGE

The Cape Romain Migratory Bird Refuge, an area of 54,061 acres of land and water on the coast of South Carolina, consisting of vast marshes, innumerable winding creeks, oyster banks, and ocean beaches, is frequented by multitudes of birds, 210 species having been noted thereon, and as many as 90 species in a day. It is attractive as a nesting area for oyster catchers, herons, and egrets, and, since its establishment, for brown pelicans. Probably 2 or 3 times as many pelicans have been noted as in previous years, and the crop of young birds is correspondingly increased. The pelicans heretofore have deposited their eggs on low sandy beaches where they were washed away by storms and high tides, but this year they nested on high sand dunes about 100 yards back from their former nesting ground.

More than 500 nests of herons have been seen on one small island, great colonies of royal and least terns lay their eggs among the sands, black skimmers nest on this refuge, marbled godwits are occasional visitors, and it is the northernmost Atlantic-coast wintering ground of the long-billed curlew. Laughing gulls nest in considerable numbers, and the wood ibis spends May and June on the refuge. Many hundreds of willets nest in grass on barrier reefs, and clapper rails are plentiful. Ducks, however, as generally throughout the country, were few in numbers this year. Various insectivorous birds also frequent this area.

Great numbers of loggerhead or giant sea turtles inhabit the small creeks and bays during the summer months and use the barrier beaches as nesting areas; other varieties of turtles may be seen, including the diamondback terrapin.

Under allotments of the National Recovery Administration and other emergency funds, headquarters buildings are under construction and other improvements have been made, consisting of a patrol boat, a boathouse and wharf, a marine railway, and a 100-foot observation tower. A 50-foot observation tower has been built in the northeastern part of the refuge, from which the two great duck-concentration areas can be kept under surveillance. An additional tower will be erected in the southwestern section.

The refuge is coming to be widely known among bird lovers, bird-conservation organizations, and naturalists as a concentration point for birds, and as a result many visitors come to see the nesting colonies and for scientific study, every effort being made by the refuge employees to assist them in their observations.

CRESCENT LAKE MIGRATORY BIRD REFUGE

The height of the spring migration at the Crescent Lake Migratory Bird Refuge in Nebraska was reached in the latter part of March, and an estimate indicated approximately 30,000 ducks there, shovelers predominating. Large numbers of snow geese stopped during the spring migration, and approximately 2,000 white pelicans were on Island Lake until early in May. About 8,000 ducks and coots, 200 white pelicans, and 450 western grebes remained during the summer. Ring-necked pheasants were fed there during the winter.

Antelope are seen frequently about the refuge and some occasionally come within its boundaries. Employment of a hunter during the winter and until early in April resulted in the elimination of coyotes from the refuge and its environs, approximately 275 of the animals having been taken.

Improvements under National Recovery Administration allotments included completion of a fence around Gimlet Lake, for stocking it with Canada geese, the birds to be donated by a resident of Nebraska; construction of dams, fireguards, fences, and approximately 2 miles of graded road; and boring of two flowing wells.

ST. MARKS MIGRATORY BIRD REFUGE

The most prominent winter visitant at the St. Marks Migratory Bird Refuge in Florida is the Canada goose, approximately 5,000 of which rested at the refuge during the season. This is a large increase over preceding years and is attributed to thorough protection and abundance of natural food. The burning over of certain areas of marsh during the latter part of January was followed by the sprouting of an abundance of young, tender shoots, which were of great assistance in providing the geese with food late in winter and early in spring. Ducks of various species frequented the refuge in goodly numbers, and many species of shore, marsh, upland-game, and insectivorous birds find a haven on the area. Nesting birds include clapper rails, eastern willets, Wilson's plover, quail, doves, turkeys, and various insectivorous species. Alligators and turtles are also numerous.

Considerable improvement work was done during the year around the headquarters, a cabin was built for the use of patrolmen, fire lanes were constructed, and part of the boundary line was cleared and marked.

SWANQUARTER MIGRATORY BIRD REFUGE

On the Swanquarter Migratory Bird Refuge in North Carolina many improvements have been effected with the aid of the Civilian Conservation Corps camp stationed there for the past 2 years. These include the construction of 11½ miles of fire lanes, about 5 miles of it 30 feet wide, 3 miles of foot trails, a boathouse, pumphouse, and garage at headquarters, 1,350 feet of sea wall to prevent washing of the shore line, and 2 look-out towers. In addition, improvements were made around headquarters; much road work was done, including graveling, sodding, and cleaning; the entire refuge was posted; considerable ditching, staking, and spraying were undertaken for mosquito control; and there was a general clean-up of 40 acres for fire prevention.

Wild fowl increased at Swanquarter about 20 percent over the previous year, probably owing in part to the reduced food in Mattamuskeet Lake, which occasioned the passage of the birds back and forth from one refuge to the other. A 50-percent increase has been noted in quail on this refuge, and the same percentage of increase has been observed in deer, bears, and squirrels.

MATTAMUSKEET MIGRATORY WATERFOWL REFUGE

Mattamuskeet Lake, Hyde County, N. C., purchased under emergency funds, was established as a migratory waterfowl refuge by Executive order of December 10, 1934. It consists of approximately 50,000 acres of land and water being restored as part of the waterfowl program. Swans, geese, and many species of ducks—principally pintails, widgeons, mallards, and black ducks—are found in numbers on the water areas. It is expected that the lake, which is being permitted to restore itself naturally, will again attract large concentrations of waterfowl. During the winter a number of crippled ducks and geese were picked up on the lake and placed in a pen for banding and release when fully recovered.

Improvement work undertaken with the aid of the nearby Swanquarter Civilian Conservation Corps camp, consisted of cutting 15 miles of boundary

trail, seeding 120 acres to corn, soybeans, and rice, and transplanting 5,000 wild celery and sago pondweed plants. Some unneeded buildings were razed, 2 garages were partially completed, and 5 structures were moved to higher ground. Considerable work was done on a hydrographic survey for increasing the wild-fowl food in the lake.

Two areas of 5,000 acres each were set aside for hunting and administration in cooperation with the State Department of Conservation. Birds taken included 1,860 geese and 625 ducks.

UPPER MISSISSIPPI RIVER WILDLIFE REFUGE

The drought and low-water conditions that prevailed on the Upper Mississippi River Wildlife and Fish Refuge throughout most of the year 1934 continued until the middle of August, when the river reached its lowest stage in 70 years, river stages being first recorded in 1864. Early in the fall, however, just prior to the opening of the hunting season, a generous rainfall raised the river sufficiently to bring water into lakes and marshes that had long been dry. As a consequence, conditions attractive for waterfowl prevailed generally throughout the refuge during the hunting season, and in certain sections the concentrations were noteworthy. The most outstanding concentration, and one that continued for several weeks, was in the so-called "Winnieshiek Bottoms", in Wisconsin. Old residents stated that more ducks came to that area than for many years. On the whole, waterfowl conditions on the refuge were more favorable than during any fall within recent years, the mallard being the predominating species.

During the winter, the watershed of the upper Mississippi River received a heavier snowfall than in many years. As a result during the spring the river within the refuge reached its highest stage since 1922, overflowing cornfields, bottom-land meadows, and wooded sections, and considerable numbers of waterfowl were attracted to these areas on their northern migration. So scattered were they, however, that it was difficult to make anything like an accurate estimate of their numbers, but the consensus of experienced observers was that although present in considerable numbers the birds were perhaps 25 percent less numerous than in the preceding spring.

The drought conditions that had previously prevailed contributed largely to a reduction in the population of muskrats, the chief fur resource of the refuge, and no public trapping of fur animals was permitted during the year.

There were practically no fires of any consequence, compared with the prolonged and destructive ones that occurred last year. The improvement was due to high-water conditions during fall and spring and to the fact that the ground was covered with snow throughout the entire winter.

The heavy blanket of snow from November until late in March raised a greater problem than in any year since the establishment of the refuge in caring for pheasants, quail, prairie chickens, and other upland birds. It was necessary to equip rangers with snowshoes to enable them to reach the feeding stations for replenishing supplies. Under conditions thus prevailing, the upland birds, including not only those resident within the refuge but in surrounding areas, were almost completely dependent for existence during the winter months upon the artificial feeding stations thus maintained. About the same number of upland game birds was noted as during the preceding year, the maintenance of their numbers being due to the artificial feeding operations during the winter and protection against hunting and fires.

Where arrangements could be made for having grain planted and cared for, many patches, principally corn and wheatland milo, were planted on suitable land throughout the refuge.

The 9-foot channel of the upper Mississippi River, long contemplated and under various stages of construction during the past 2 or 3 years, has now become a reality in certain areas of the refuge. The Alma and Whitman pools, inundating thousands of acres of bottom land between Winona and Wabasha, Minn., were filled about June 1 and thus for the first time afforded opportunity to observe water levels and the actual extent of inundation. The results of such partial flooding and of maintenance throughout the year of stabilized levels in the pool areas will be watched to note the effect on wildlife and wildlife environment.

The policy of issuing free permits to needy persons to gather fuel for domestic use was continued. Permittees were authorized to cut wood from areas certain to be flooded by the 9-foot channel. No grazing permits were issued, as

the emergency of the previous year that impelled farmers to graze their suffering livestock on the refuge no longer existed. The conditions that led to the livestock grazing last year were responsible also for an unprecedented demand for the privilege of cutting hay on the refuge meadows. A nominal charge per ton was made, and it was further required that all mowers be equipped with a flushing device to insure the protection of ground-nesting birds ahead of the mower. Other precautionary measures were taken to insure against interference with wildlife.

BEAR RIVER MIGRATORY BIRD REFUGE

In comparison with the supply of waterfowl over the country as a whole, the concentration of birds at the Bear River Migratory Bird Refuge, Utah, has been encouraging. With the exception of certain species that are apparently becoming scarce, the refuge continues to attract a great variety of birds in large numbers. The concentration has not been so great, however, as in previous years, and this indicates a decrease in the general supply. The most notable shortage was among redhead ducks, and, to a lesser extent among cinnamon teal. Though the total number of waterfowl visiting the refuge shows a decrease, greater numbers are without question breeding there.

The past winter was so unusually mild that, with most of the flooded area free of ice, except for a few days, the birds had access to food, and many remained throughout most of the winter, though during a rather heavy freeze, for about 10 days, the number there was temporarily reduced about 80 percent. Between 5,000 and 6,000 whistling swans remained on the refuge until April. This is the second successive winter that large flocks of swans did not migrate farther south; furthermore, they now winter on the refuge proper, whereas until 2 years ago most of them stayed on adjoining areas.

Though the snowfall on the lowlands was exceptionally light, a heavy fall in many of the mountain drainage areas increased the spring stream flows materially, and this, coupled with numerous heavy spring rains, produced an ample spring run-off and made the prospects favorable for maintained water during the summer. The wet spring and adequate water in Bear River produced a rank and luxuriant growth of vegetation. Never in the 5 years since the refuge project was completed has there been such a bountiful supply of duck food. Some experimental plantings were made of various grains.

Since the serious outbreak of botulism, or western duck sickness, in 1932, there has been a constant decrease in mortality and the number of birds afflicted. Not more than half a dozen birds appeared to be afflicted last spring, and not a single one was found that had died from the disease.

A total of 1,044 ducks and coots were banded at this refuge during the year. It is worthy of note that the number of redheads banded in each of the past 6 years has constantly decreased—from 1,010 in 1929 to 54 in 1934.

Nesting conditions were favorable, though breeding began late, and many of the ducks were still incubating at the end of the year. More birds nested on the refuge than at any previous time since its completion, and a high percentage of hatch is indicated with but little mortality among the young. In an effort to improve the nesting conditions, 7 artificial islands were constructed in the interior of the various units, in addition to 1 previously constructed. These eight nesting havens are proving particularly attractive to shore birds.

Seven nests of the Caspian tern were found on the division dike between units 3 and 4, establishing a new nesting record for the refuge. A small colony of these terns has nested on an island in Utah Lake, 100 miles to the south, but this is the first nesting record north of that point in Utah.

An extensive nesting survey was undertaken last spring, and upon its completion much valuable information will have been obtained on numbers of breeding birds and eggs, and percentage of hatch.

During the fall hunting season 2,298 hunters took 7,559 waterfowl on areas within the refuge boundaries open to shooting.

Improvements under National Recovery Administration allotments were continued and have been largely completed. Emergency refuge-development funds provided for construction of artificial nesting islands, which were completed to the extent the allotment permitted. Work finished under National Recovery Administration funds included an administration building, a tool house, and 17 miles of telephone line, and much was accomplished in water control and road repairs. The work of a Civilian Conservation Corps camp, established on this

area for the fourth and fifth periods, included stream and lake-bank protection under which 902,000 square yards of lake shore along the dike line were protected against erosion and wave action, completion of 6 miles of stock fence and 10 miles of telephone line, building of a vehicle bridge, erection of a 100-foot observation tower, and installation of a water-control structure in a canal.

BIG-GAME PRESERVES

Shortage of feed occasioned by drought necessitated the feeding of buffalo and other big-game animals on all the fenced preserves during the winter of 1934–35. An acute feed situation also developed at the Elk Refuge in Wyoming in connection with a heavy concentration of elk on the feeding grounds during the long winter. Curtailment of numbers in all restricted herds was accomplished through surplus disposal. As in previous years, most of these animals were donated for use as food by Indians on nearby agencies. In some instances, however, live animals were transferred for stocking enclosures constructed on some of the Indian reservations. Exclusive of 1,177 big-game animals on the Wichita Mountains Wildlife Refuge, Okla., the number of big-game animals on fenced enclosures maintained by the Biological Survey at the close of the year was 1,198, which is a decrease of 360 animals on these four refuges since 1934, due to disposals because of feed shortage (table 6).

TABLE 6.—*Animals on fenced big-game preserves maintained by the Bureau of Biological Survey* [1]

Preserve	Buffalo	Elk	Antelope	Mountain sheep	Deer		Total [2]	Young born in calendar year 1934 [3]		
					White-tailed	Mule		Buffalo	Antelope	Mountain sheep
National Bison Range, Mont.	441	103	-------	53	[4] 28	[4] 47	672	117	-------	8
Wind Cave Game Preserve, S. Dak. [5]	180	[4] 65	[4] 39	-------	2	[4] 30	316	51	12	-------
Niobrara Game Preserve, Nebr.	134	38	12	-------	5	1	190	33	2	-------
Sullys Hill Game Preserve, N. Dak.	17	[4] 20	-------	-------	14	-------	51	7	-------	-------
Wichita Mountains Wildlife Refuge, Okla. [6]	327	[4] 245	-------	-------	[4] 605	-------	1,177	72	-------	-------
Total	1,099	[4] 471	[4] 51	53	[4] 654	[4] 78	2,406	280	14	8

[1] With the exception of those of young born, figures are for June 30, 1935.
[2] Including estimates.
[3] Young of elk and deer omitted, as in most cases estimates only could be made; but during the calendar year approximately 145 elk calves and 42 fawns of mule deer and 108 of white-tailed deer were observed on the preserves.
[4] Estimated.
[5] Abolished under act of Congress of June 15, 1935, and the area and the big-game animals thereon transferred to the Department of the Interior for administration in connection with the Wind Cave National Park, effective July 1, 1935.
[6] Transferred by order of the Secretary of Agriculture from the Forest Service to the Biological Survey, effective Apr. 1, 1935.

NATIONAL BISON RANGE

In a disastrous fire started by lightning at the National Bison Range in Montana early in the morning of August 11, high winds swept the flames across grass and timberland made highly inflammable by the long-prevailing drought. After burning over about 5,300 acres and threatening destruction of the herds of big-game animals on the range, it was brought under control the next day, through cooperation of Forest Service employees and local men, assisting the force at the Bison Range. No losses of animals resulted so far as known, but vegetation and timber were destroyed over a wide area. Forage on the range made a satisfactory growth during the spring, however, and there was little permanent injury to the grass roots on the burned-over area. Shortage of range feed as a result of the fire made it necessary, however, to corral the buffalo in spring and to feed them for 2 months that the grasses might get a good start before the animals were turned out to graze. Thirty-eight acres on the range have been planted to crested wheatgrass.

Surplus big-game animals disposed of during the year included 178 buffalo, 77 elk, and 51 mule deer, of which 152 buffalo, the 77 elk, and 14 deer were transferred to Indian agencies, most of them for use as meat, but 19 of the buffalo were furnished to the Crow Indian Agency, Mont., for breeding purposes. All animals on the range (table 6) are thriving, including the albino buffalo, now 2 years old, which continues to be a great attraction to visitors.

Chinese pheasants, Hungarian partridges, and blue and ruffed grouse are found on the range, the pheasants being especially numerous, and during the open season thousands of them flock to the refuge. These birds and also ducks and deer were fed during the extremely cold weather in January. Canada and snow geese were observed in about the usual numbers, and a few swans and canvasbacks were seen, though these ducks do not visit this section in large numbers at any time. All the common ducks were noted. To control the numerous coyotes on the range a trapper was employed during June. Beavers on Mission Creek are thriving.

A Civilian Conservation Corps camp established on the range during the last quarter of the fiscal year improved roads and trails and completed approximately 4½ miles of fireguards. In addition, under National Recovery Administration funds the headquarters buildings were repaired and new roads were built.

WIND CAVE GAME PRESERVE

The severe general drought throughout the West made forage for all game animals unduly short on the Wind Cave Game Preserve in South Dakota and many of the buffalo were in rather poor condition. Forage growth during the wet, cold spring of 1935 was excellent, and practically all the animals (table 6) are in fine shape. By the end of June the range was in better condition than for several years, and a heavy seed crop of practically all forage plants was assured.

Surplus animals disposed of included 98 buffalo and 3 elk. Of these, 82 buffalo were transferred to the Pine Ridge Indian Agency for use as meat and for stocking a new buffalo pasture. Ten antelope fawns were seen during the year, but there were unusually heavy losses during the winter, 29 having been found dead. These losses were partly due to the fact that drought caused an extreme shortage of feed and forced the antelope to graze in the same pasture with buffalo and elk. These latter animals have learned to eat hay provided for them, but the antelope had not been fed regularly and apparently ignored feed put out. About 70 tons of hay shipped from Niobrara Game Preserve, Nebr., served to prevent unduly heavy losses of all big game except the antelope. Coyotes also were thought to have been responsible for losses of antelope, and control operations were undertaken.

Under the act of June 15, 1935 (Public, 148, 74th Cong.), Wind Cave Game Preserve was abolished and the area and the big-game animals thereon transferred to the Department of the Interior for administration in connection with the Wind Cave National Park, effective July 1, 1935. During the period of travel ended last September there were 15,205 visitors to the preserve.

ELK REFUGE

The feeding of the elk last winter at the Elk Refuge in Jackson Hole, Wyo., began on January 1 and continued until April 20. About 9,700 elk consumed approximately 3 261 tons of hay, 202 tons of cottonseed cake, and 50 tons of corn, of which 660 tons of hay were harvested on the refuge in the summer of 1934 and 170 tons of cottonseed cake and the corn were furnished by the State game department. The long winter and the large number of elk concentrated on the refuge brought about an acute feed situation, which necessitated emergency purchases amounting to $30,000. All feed reserves except 268 tons of cottonseed cake were exhausted, and an emergency item of $25,000 pending in the deficiency bill at the end of the fiscal year has since been made available for the purchase of feed for the coming winter. The State game department established three feeding grounds south of the town of Jackson, where 1,200 to 1,600 elk consumed about 400 tons of hay and 280 tons of cottonseed cake.

About 700 elk died on and adjacent to the feeding grounds, of which approximately 90 percent were calves that had contracted calf diphtheria. In all, 3,806 elk were removed from the herd, including 3,246 killed by hunters, 300 by the State game department for relief purposes, and 260 wounded or killed

during the hunting season and not recovered. A census was taken during the latter part of March and early in April, the elk on the feeding grounds being counted from the ground, and those wintering in outlying districts from an airplane. This count showed a total of 22,035, an increase of 2,180 over the previous census taken in 1932.

Under an appropriation made by Congress in June for the acquisition of lands for wildlife-refuge purposes, it is contemplated that the winter-feeding problems associated with the maintenance of the elk will be reduced to the minimum by acquisition of much-needed adjacent lands.

Deer have greatly increased in Jackson Hole during the past 13 years, and it is estimated that there are now 500 in the section. Twelve of these animals stayed on the refuge during the spring. About the same number of migrating waterfowl visited the refuge as in previous seasons, and some mallards, teal, and gadwall nested there. Coyotes have increased in number.

SULLYS HILL GAME PRESERVE

In order to benefit the pastures, more than the usual number of big-game animals were disposed of as surplus from the Sullys Hill Game Preserve in North Dakota. These included 10 buffalo, 26 elk, and 1 white-tailed deer, of which 6 buffalo and 6 elk were transferred to the Fort Totten Indian School for use as meat. The white-tailed deer herd was increased by the donation of 2 by a resident of North Dakota. All animals on the preserve (table 6) are generally in good condition.

About the same number of waterfowl were in the vicinity of Sullys Hill as last year, but the number of young birds raised may show an increase. Song and insectivorous birds have been more abundant than for many years. Pheasants and partridges also are increasing, but grouse and prairie chickens have decreased. Many upland game birds were saved from starvation during the last half of the winter by feeding them at suitable places. About 90 bushels of mixed grain was used for this purpose.

Road and trail improvement has been accomplished, the bed of a small lake in the picnic grounds was deepened along the shore, and a steel-piling cut-off dam along the lower side of this lake was completed under National Recovery Administration allotments. Visitors to the preserve during the year numbered 15,118, with 2,908 cars.

NIOBRARA GAME PRESERVE

At the close of the year the buffalo, elk, antelope, and deer on the Niobrara Game Preserve in Nebraska were in excellent condition, the elk being in better shape than for a number of years. Surplus animals, consisting of 30 buffalo and 35 elk, were disposed of, including 9 buffalo and 24 elk for use as meat by Indians on the Rosebud Agency. Four fine buffalo bulls were received from Custer State Park, S. Dak., in exchange for a like number from the Niobrara herd, and 1 young white-tailed buck deer was donated by the city park at Fort Dodge, Iowa.

Coyotes, jack rabbits, and fur-bearing animals have been increasing to such an extent that steps must be taken to curb their abundance, but pocket gophers have been practically eliminated from the area.

Encouraged by the abundance of spring rainfall, more birds nested on the preserve than during the previous 3 years. A few mallard ducks that had congregated on the ponds kept open by spring water had to be fed to carry them through the winter. Some prairie chickens and grouse also were fed until April, and these with pheasants and quail nested on the preserve in about the usual numbers.

Grazing conditions were better than at any time since 1930, though in March the most severe dust storm ever experienced in the West reached this preserve, which is located in the midst of a drought-stricken area that, in addition, had been eaten bare by grasshoppers. The great clouds of dust covered buildings and vegetation with a coating of soil so deep that it appeared doubtful whether vegetation would grow, but in April a heavy rainfall began and produced a spendid growth of grass on the pasture and hay lands.

Numerous improvements were begun or completed during the year, including a garage and 2 storage buildings, a look-out tower in the north big-game pasture, 2 windmills, and several wells. The west arm of the preserve was entirely fenced with a barbed-wire stock fence, an additional holding pen

was constructed to include part of a pond that affords a watering place for any game animals retained there, about 19 miles of truck trails were built in the big-game pasture, the construction of 2 dams has been begun, exhibition pastures for the animals have been improved, islands on which shore birds later nested were built in various ponds, and approximately 100,000 trees were planted on a little more than 200 acres.

CHARLES SHELDON ANTELOPE REFUGE

Breaking almost a decade of drought conditions in northwestern Nevada, precipitation for the winter 1934–35 reached a total of 10.5 inches and on the Charles Sheldon Antelope Refuge averted a serious situation for the summer of 1935. Range grasses have been restored in amazing abundance, and the water tables of springs have risen. These favorable conditions followed a fall in which the flow from springs was almost nothing in most favored localities and failed completely in others. Sufficient water for the 48-square-mile sanctuary was to be had only by intensive development of a dozen seeps and by the fencing out of domestic stock. As a result, between 1,500 and 1,600 antelope congregated on the range during September and October, sage grouse frequented the springs in more than normal numbers, mule deer moved in from outside areas, and migratory birds, especially doves, showed a large increase. Antelope left the refuge following the first November snows and after wintering well returned in good condition late in March with the beginning of grass growth on the plateaus. The fawn crop appeared normal, twins predominating.

No large increase in total numbers of antelope has been noted on the refuge proper during the past few years. Mule deer, however, are frequenting the refuge more and more and are often seen by day in open areas, but the sage grouse shortage is still acute.

Under the National Recovery Administration development program a barn, a combination implement shed, tool house, and blacksmith shop, a tank house, and a garage have been built, and work has been done for water conservation and for road, trail, and firebreak construction. Some 22 miles of fire trails were constructed for quick entry into sections where the fire hazard would be most pronounced. The erection of the stock fence has stopped the destructive overgrazing by livestock prevalent in the previous years, and the beneficial effects from this improvement were immediate.

A Civilian Conservation Corps camp has been established, and early in June the work program for the refuge was well under way. It includes the building of 48 miles of telephone line, construction of check dams, road and trail development, reseeding, and other beneficial operations.

WICHITA MOUNTAINS WILDLIFE REFUGE

Administration of the Wichita National Forest and Game Preserve in Oklahoma was transferred on April 1, 1935, from the Forest Service to the Biological Survey. This area was once part of the Apache, Comanche, and Kiowa Reservation in the old Indian Territory, and when the reservation was thrown open to settlement in 1901, a tract of about 60,000 acres was reserved by Presidential proclamation (32 Stat., pt. 2, p. 1973), as a forest reserve, first under the jurisdiction of the Department of the Interior, and 4 years later under the Forest Service of the Department of Agriculture. In 1905, by a proclamation of President Theodore Roosevelt, based on an act of Congress (33 Stat., 614), the Wichita area was further designated as a national game preserve and by act of March 4, 1907, when all forest reserves were designated as national forests, this area became the Wichita National Forest and Game Preserve.

The preserve supports herds (table 6) of buffalo, elk, and Texas longhorns within fenced enclosures. The area is also well stocked with native white-tailed deer, as well as turkeys, quail, and prairie chickens, and 49 different species of birds have been noted there in a single week. Under the administration of the Biological Survey part of this game preserve will constitute a major wildlife research station, where much-needed investigations will be made of big-game animals as well as of upland game and migratory birds.

Under Public Works Administration and Emergency Conservation Works programs, 22 small lakes have been developed to serve as resting grounds for migratory birds and possibly in the future as breeding and nesting areas for certain species. Considerable road work, camp-ground development, landscaping, dam construction, and many other improvements have been accomplished.

CONSERVATION THROUGH LAW ENFORCEMENT

FEDERAL STATUTES ADMINISTERED

Educational methods as well as the strong arm of the law are used by the Biological Survey in the enforcement of the statutes for which it is responsible. These include legislation under the Migratory Bird Treaty, negotiated in 1916 to protect birds that are the common property of the United States and Canada, as follows: The Migratory Bird Treaty Act of 1918, authorizing regulation of wild-fowl hunting; the Migratory Bird Conservation Act of 1929, authorizing the establishment of bird refuges; and the Migratory Bird Hunting Stamp Act of 1934, under which waterfowl hunters are required to have a Federal hunting stamp in their possession. Other wildlife conservation laws assigned to the Bureau for administration are the Lacey Act of 1900, to regulate interstate and foreign shipments of wild mammals and birds; a law protecting animal life and property on Federal wildlife refuges; and, through the Alaska Game Commission, the Alaska game law of 1925.

The Hunting Stamp Act and the Lacey Act were amended on June 15, 1935, in the interest of more effective administration. The amendment to the former makes the stamp readily available to nonhunter purchasers wishing thus to aid in the program of refuge establishment; and in the case of a hunter it requires validation in the form of his signature across its face in ink. The original Lacey Act was limited in scope, covering shipments made by common carrier only; the amendment makes it applicable to shipments of any character in interstate or foreign commerce. The penalty for violation of the statute is now substantially increased, and it also carries full authority for enforcement.

REGULATORY ACTION

A most informative meeting of the advisory board, Migratory Bird Treaty Act, was held in the new auditorium of the Department on July 11 and 12, 1934, with 21 members in attendance. In the absence of the Secretary of Agriculture, the board was welcomed by the Assistant Secretary and instructed as to procedure. It heard several members of the Bureau present facts that had been collected with respect to the abundance of waterfowl, nesting investigations, migration statistics, and lines of flight, and the plans being made for the waterfowl-restoration program. Maps of the waterfowl flyways and charts indicating the ratio of kill and the breeding areas, also were displayed and explained.

The regulations for 1934–35, approved by the President on August 20, 1934, provided among other things for a complete readjustment of States for hunting waterfowl, jacksnipe, and coot, the season being reduced from 60 shooting days to not exceeding 30, selected by the State game officials of each State between the period October 1 and January 13. By a further amendment the taking of doves was not permitted by means of bait, and the taking of migratory waterfowl by means of bait was allowed only where operations were conducted under permit from the Chief of the Bureau of Biological Survey, the permittees being required to keep records and at the end of the season to furnish information as to the kill of waterfowl by species, and also to indicate the number of hunters, the total number of days they were shooting, the kinds of food employed, and the intervals of feeding the birds. Other amendments made the hours for hunting certain migratory game birds run from sunrise to sunset, instead of from half an hour before sunrise to sunset; and cut the bag limit on certain imperiled ducks from 8 to 5 a day and reduced the possession limit of such birds from 16 to 10.

An amendment to the regulations approved on February 2, 1935, placing a three-shell limit on autoloading and other repeating shotguns in the hunting of migratory game birds becomes a part of the regulations effective with the hunting season for the fall of 1935, which were approved by the President after the close of the year being reported upon.

After press announcement of the details of the changes, the regulations for 1934 were published in the Service and Regulatory Announcements series (BS–79), and the open season dates were shown on a poster (no. 54–Bi) issued on August 31. Other publications relating to the enforcement of conservation laws included the annual bulletin on the game laws (Farmers' Bull. 1742), having on the title page a reproduction of the hunting stamp for the year; a mimeographed abstract of the State fur laws affecting trapping seasons; the annual directory of Federal, State, and Canadian game-protection officials

(Misc. Pub. 211); and in the 1935 Yearbook of Agriculture (p. 724) a table on hunters' licenses issued by States, with total money returns for the seasons 1932 and 1933. Many press statements on these and other conservation subjects were issued during the year for educational purposes and to apprise the public of changes in the regulations (including those under the Alaska Game Law—Alaska Game Commission Cirs. nos. 11 and 12).

Visual information on game conservation included specially prepared exhibits displayed by the Bureau at sportsmen's shows and at expositions featuring wildlife subjects. One emphasized the need and value of farmer cooperation by use of uncultivated parts of the farm as breeding, feeding, and resting areas for wild fowl and other game. Another described land areas being acquired for waterfowl refuges. Two other exhibits stressed the decrease of shore birds and upland-game birds and the need for protection through restrictions on hunting and for general observance of the game laws and regulations.

ACTIVITIES OF UNITED STATES GAME-MANAGEMENT AGENTS

Advances on proceeds of sales of migratory-bird hunting stamps permitted increasing the regular force of 22 United States game-management agents to 25, and employing 32 deputies. All were selected in accordance with civil-service regulations, to work from October to April. For enforcement purposes the country was divided into eight regions in charge of regional directors who supervise the operations of the game-management agents and deputies. Each agent is held directly responsible for Federal game-law observance within his district. The deputy agents were organized in 8 mobile units, or "flying squadrons," of 4 men each, to patrol the major waterfowl-concentration areas. They were available also at all times on call to assist any game agent in apprehending violators.

As the migratory birds moved south with the approach of cold weather, the northern agents and squadrons worked southward with them and patrolled the Southern States all winter. When the waterfowl returned on their spring migration, the first flights were accompanied by the northern agents and squadrons. Later, as the majority of the ducks and geese were leaving the South, the southern agents and deputies in turn followed. This method of game protection proved very satisfactory, as several relays of trained enforcement officers were continuously available to patrol the major flyways as the birds crossed the country to their nesting grounds. News of the presence of the officers spread like wildfire, and soon the violators were on the run. A number were caught red-handed, some sought avenues of escape, and many other former spring shooters, fearful of apprehension and unwilling to assume the risk, were content to leave their guns on the rack.

In most States enforcement activities had the hearty approval of the game commissions, and in several the State game wardens and Federal agents worked together in a coordinated program that produced gratifying results. The combined forces not only apprehended many well-known and persistent game-law violators, but the cooperative patrol in the intensified campaign saved thousands of migratory birds that otherwise would have been illegally killed by trapping and shooting. A few instances of excellent enforcement work may be cited from a large number in many States to present a clear picture of the nature and extent of the field work of the agents and deputies.

To cut off the supply and combat the illegal sale of ducks and geese in night clubs, hotels, and cafes, it was necessary to detail a few agents to undercover work. Such methods were used, however, only against persons and establishments known to handle game illegally and for profit. One agent and a deputy effectively posed as surveyors and ran a line directly through a duck-supply depot, where they found several hundred dead wild ducks and geese that were being held for disposal to an exclusive trade.

To another agent was assigned the duty of posing as a professional duck buyer for exclusive night clubs in Chicago. During his operations he bought ducks killed illegally from 44 well-known duck bootleggers. In this operation the agent worked with a man who was familiar with the haunts of the outlaws, and the two, with heavy growths of whiskers, looked like kindred spirits. The agent himself was so disreputable looking that the hotel clerk made it evident that he feared he would not be paid for the accommodations furnished, and later looked on with awe when the agent, on checking out, produced a sizable roll of greenbacks. Nearly all the cases have been handled successfully in Federal court.

Other agents, in the guise of wealthy salmon packers, entered exclusive western night clubs and cafes and were served wild duck. These and other similar operations of game agents and deputies resulted in more than 100 arrests and convictions in Federal courts for the sale of waterfowl.

Because of known violations on an island in eastern waters, an agent performed under-cover work with the aid of a special agent from the Department of Justice. As no stranger could approach the island unobserved except after midnight, the agent made his visit in another role, in order to allay any suspicions and build up some sort of friendly relationships. Before being accepted by the islanders, the Bureau's agent first had to submit to lengthy questioning as to whether he was not a State game warden. To obtain the facts he posed as a collector of birds and made up the skins in the presence of onlookers. He hired one or more of the local residents as guides, and thus was enabled to obtain much of the information he was seeking, and incidentally learned what would happen to any game warden who might come snooping around. The agent was able to watch the trapping and unlawful shooting of ducks, and to obtain data regarding the market for them. Many of the trappers were persons without other means of support than that derived from the sale of fish and ducks.

To obtain respect for the Federal law, the agent afterward decided to undertake an educational campaign with the aid of the local minister. Becoming to all intents and purposes one of the islanders, he lived with them for several weeks and attended their church. As a result he was able to have removed from the island 3 large-bore guns 8 to 10 feet long and weighing as much as 175 pounds. The educational program was actually productive of fine results, and the means of saving many birds.

A skillful piece of work in connection with duck trappers was done by an agent operating in the same general region. He learned that ducks were being shipped in eel kegs to New York, Pennsylvania, and Illinois. Inquiry disclosed that the shipper was using the name of a person who had been dead some months. This handicap did not serve to stop the agent, and by persistence and a process of elimination he finally located and arrested the violator. This man was afterward arraigned in Federal court and sentenced to serve 6 months in jail on 1 count. On 4 remaining counts he was sentenced to serve 6 months each, the terms to run consecutively, but suspended for 5 years, with a reminder by the court that if he were ever arraigned again on a game-law violation, he would have to serve this additional sentence.

Two agents in a southern State watched 5 hunters shoot simultaneously at ducks and assisted them in picking up 112 birds, which they then seized. One of these agents also apprehended 7 persons killing plovers. Four of these hunters were officers on a city police force, 1 was assigned to the city prison farm, and 2 were prominent citizens. Incidentally they had been transported to the shooting grounds, some 40 miles from town, in police radio cars. Fines of $100 each were suspended in these 7 cases, conditioned upon the offenders refraining from any form of hunting for 1 year.

Several hundred waterfowl traps were destroyed during the year. Three swivel guns, types capable of great duck and goose destruction, killing 100 or more birds at one shot, were confiscated. The smallest gun has a 1¾-inch bore and is 7 feet 9 inches long, while the largest is 9 feet 6 inches long and has a 2-inch bore.

HAZARDS OF THE WORK

On December 10, 1934, a fearless and efficient veteran game agent of the Bureau, E. Bradford Whitehead, lost his life in line of duty, from wounds received 2 days before at the hands of a game-law violator. The assault occurred near Savannah, Ga., when the Federal officer, while inspecting the hunter's game bag, received a charge of buckshot in the left side, shoulder, and arm. Within an hour after the shooting, the assailant himself, while attempting to escape arrest, was shot and killed by State officers. Because of the continued assaults of this kind, the Bureau is keenly interested in pending legislation to provide punishment for the killing or assaulting of Federal officers; this bill (H. R. 7680) has passed the House of Representatives and was reported favorably by the Senate Committee on the Judiciary.

Assistance rendered by the Coast Guard in February saved a deputy game-management agent of the Bureau from death by freezing and starvation when for 10 days he was marooned in subzero weather on an island in Chesapeake

Bay, Md. The agent was doing law-enforcement work in the section and assisting in the Bureau's January waterfowl inventory, when a 2-day rain suddenly turned to sleet and snow. Having food and supplies for only 2 weeks, he was sharing them with a private trapper who sought shelter from the storm on the island. The plight of the two men was discovered by an airplane which was sent out by a Washington newspaper to search for the deputy and to drop food to the island, after which a cutter of the Coast Guard, breaking through the ice, reached the men and made the rescue. A commercial airship which also had gone from Washington to effect the rescue arrived and landed a searching party shortly afterward, only to discover that the men had been removed.

LAW VIOLATIONS AND PENALTIES

MIGRATORY BIRD TREATY ACT CASES

There was an increase of 163 over the preceding fiscal year in the number of cases of violation of the Migratory Bird Treaty Act reported by the Department for prosecution, an increase in convictions, and a slight decrease in the number of cases disposed of (table 7).

On account of lack of evidence, youthfulness of the accused, or other satisfactory reasons, 73 cases were not recommended for prosecution. Fines and costs ranging from $1 to $500 and aggregating $7,156 were assessed in the Federal courts. Jail sentences were imposed as follows: 10 days (10), 20 days (1), 30 days (12), 60 days (9), 90 days (2), 120 days (1), 180 days (1). In 18 cases jail sentences ranging from 10 days to 6 months were suspended. Defendants in 54 cases were placed on probation for 6 months to 5 years. One case tried before a jury resulted in a verdict of guilty. Seizures of migratory game birds had an estimated value of $1,400, and such birds as could be utilized for food were donated to hospitals and other public charitable institutions.

Demurrers filed at St. Louis, Mo., by two persons charged with killing mourning doves by means of bait, contending that the Migratory Bird Treaty Act was an attempt by Congress to delegate legislative powers to an administrative officer and therefore unconstitutional, were overruled by the court on April 24, 1935.

TABLE 7.—*Cases of violation of the Migratory Bird Treaty Act disposed of during the fiscal year and cases still pending June 30, 1935*

Cases disposed of	Number	Cases pending	Number
Convictions	358	Pending from former year	349
Dismissals	29	New cases	615
Verdicts of not guilty	8		
Adjudged guilty by the court	3	Total	964
No bills found	2	Disposed of	424
Nol-prossed	18		
Prosecutions abandoned	6	Pending at end of year	540
Total	424		

In California a well-directed drive culminated in obtaining evidence against 47 duck sellers, including night clubs and restaurants. Of this number 33 cases were prosecuted in State court, where fines aggregating $2,495 were imposed. The remainder, 14 cases, have been successfully terminated in Federal courts in California, with fines running as high as $500, and aggregating $1,700. In two of the cases the defendants were sentenced to serve 30 and 90 days, respectively, in jail.

A vigorous campaign in Louisiana against out-of-season shooters and sellers of wild fowl resulted in the apprehension of 72 individuals. In 3 cases the jury returned a not-guilty verdict. Most of the remaining cases have been terminated, with jail sentences as high as 120 days in 16 cases.

On the Susquehanna Flats in Maryland agents found the guns, hunting coats, and licenses of hunters and several bags of freshly killed ducks—39 canvasbacks and 45 scaups. Three hunters afterwards charged with possessing ducks in excess of the bag limit paid fines and costs of $47.50 each. In one other case in the same district the court, in imposing a fine of $100 against a restaurant operator charged with selling 6 ducks, indicated in emphatic language that the commercial handling of wild fowl is a serious offense and completely subversive of the purpose of the law.

MIGRATORY BIRD CONSERVATION ACT CASE

The first case under the Migratory Bird Conservation Act, which was based on the unlawful taking of 1,350 turtle eggs on the Cape Romain Migratory Bird Refuge in South Carolina, was reported during the year.

MIGRATORY BIRD HUNTING STAMP ACT CASES

Three cases involving infractions of the Migratory Bird Hunting Stamp Act were reported for prosecution, of which 2 were terminated, 1 in Virginia and 1 in Louisiana, by fines of $10 each. The activities of agents under this statute were chiefly of an educational nature during the first year. Many sportsmen who had not yet become familiar with the provisions of the law were cautioned to stop hunting and given opportunity to purchase the required stamp.

WILDLIFE REFUGE TRESPASS CASES

Three new cases under the law protecting wildlife and Government property on Federal reservations (sec. 84, Criminal Code) were reported for prosecution, 1 in Nebraska, 1 in New Jersey, and 1 in Wyoming.

LACEY ACT CASES

One case, still pending, involving the unlawful interstate shipment of a deer from Michigan to Ohio, was reported for prosecution during the year. Agents working under the Lacey Act inspected records of fur at receiving centers in 14 States and discovered evidence of many infractions of State game laws. Information regarding 2,361 shipments containing skins of fur-bearing animals illegally taken or shipped were transmitted to State game departments in 22 States and Alaska. In 13 States 74 cases based on information originally furnished by the Survey were closed by fines and costs of $1,217, and in 2 of these States jail sentences from 5 to 30 days were imposed in 5 cases. In 834 other investigations reported on by the States it was determined that shipments had been lawfully made, and in 116 others that prosecution would be inadvisable. The game departments of 42 States were furnished evidence regarding 608 cases involving violations other than illegal interstate shipments of skins of fur-bearing animals. As a result of these prosecutions, fines and costs in State courts amounted to $11,461.10. In 2 cases the defendants were adjudged not guilty. In 438 cases convictions were obtained, while in 170 cases prosecution was not deemed desirable. Jail sentences were imposed against 14 offenders, while additional fines aggregating $512.75 were suspended.

UPPER MISSISSIPPI RIVER WILDLIFE REFUGE CASES

During the year 16 new cases indicating violations of the Upper Mississippi River Wild Life and Fish Refuge Act were reported for prosecution, of which 1 was disposed of by a suspended fine of $50, 1 by a 2-day jail sentence, 2 by suspended jail sentences of 1 year each, 1 by a suspended 3-month jail sentence, and 1 was nol-prossed.

Reservation protectors reported 52 cases relating to State game-law offenses, and of this number 21 cases resulted in convictions, in 8 the defendants were found not guilty by juries, in 11 suspended sentences were imposed, while 3 cases were dismissed. Jail sentences of 30 days each were imposed in 3 cases, 60 days each in 2 cases, and 90 days in 1 case. In 3 other cases the prisoners escaped from jail prior to trial. The fines and costs collected aggregated $739.39.

Joint regulations for the administration of this refuge were prescribed by the Secretaries of Agriculture and Commerce in September, and published as a Service and Regulatory Announcement of the Biological Survey (no. 80).

WILDLIFE CONSERVATION IN ALASKA

LAW ENFORCEMENT

Several changes were made in regulations for the 1935–36 hunting and trapping seasons under the Alaska Game Law. A close season was established for marten and beaver throughout the Territory, and bears were given added protection through close seasons and smaller bag limits in some sections. As a result of unusual increase of the Sitkan deer transplanted to the Prince

William Sound region from southeastern Alaska several years ago, a short open season, during which 1 male deer may be taken under special permit, was granted for the new district. Acting under authority given it under the Alaska Game Law, the Bureau's operating agency in the Territory—the Alaska Game Commission—initiated a $1 resident hunting license in the first judicial division.

Working under a handicap of sharply reduced funds, the active field force was held to but seven wardens to police a wilderness area nearly 590,000 square miles in extent. Patrol vessels were unable to operate sufficiently to keep pace with increased violations, and the executive office staff suffered curtailment with like effect. An allotment of $195,700 by the Public Works Administration during the previous year did, however, make it possible to construct six urgently needed patrol vessels, besides docks, floats, small storehouses, and administrative buildings for field offices and warden's living quarters.

WILDLIFE RESTOCKING PROJECTS

At a total expense of $462.36 provided by the Territorial Legislature, 225 Chinese ring-necked pheasants were transplanted from the State of Washington to the vicinity of Sitka on Baranof Island during the summer of 1934. The small herd of Roosevelt elk transplanted to the Kodiak-Afognak Islands group 6 years ago has shown a gratifying increase. In September 1934 a warden of the Commission obtained first-hand information that between 50 and 60 of these animals are now on the islands. In the Big Delta section of central Alaska approximately 75 bison are now thriving as a result of the transplanting of 23 animals from the National Bison Range, Mont., in 1928. These buffalo have never required artificial feeding in Alaska even during the severest winters. Numerous other plantings, including those of beaver, muskrat, marten, hare, squirrel, marmot, mountain goat, and deer have on the whole shown such results as to warrant continuance of this type of wildlife conservation.

INFLUENCE OF CHANGING ECONOMIC CONDITIONS

During the 10 years that the Alaska Game Law has been in operation, noticeable changes have occurred in the attitude of residents toward wildlife resources. At first there was much chafing at restrictions, the general feeling being that the game and fur was for the people to take as they saw fit, but as time has passed and the Commission's purposes have become better appreciated, there has been a slow but steady trend toward reasonable protection of wildlife. Changing economic conditions have emphasized the importance of fur and game animals in the lives of the people, and have forced a realization that for many years to come these resources must be relied upon by a large proportion of the population as a means of livelihood, and therefore must be safeguarded for them by some reliable agency. With this thought has come a clearer conception of the benefits to accrue from the annual visits of numbers of sportsmen and big-game hunters to the Territory and their spending of many thousands of dollars for a relatively small number of game trophies.

1935

IMPORTATION AND OTHER PERMITS ISSUED

PROHIBITED SPECIES EXCLUDED

It continues a fact that no forbidden species of bird or mammal has established a foothold in the United States since the passage of the Lacey Act in 1900; and that the English sparrow and starling population, then established, has not been augmented by any importations.

During the year two attempts were made by importers to bring flying foxes, or fruit bats (*Pteropus*), into this country. In the first, 4 bats were actually entered and, in violation of the regulations, immediately shipped from New York City to Chicago, having been listed in the application as "flying dogs", and the application for the permit, including a large number of miscellaneous mammals and birds, was not sent to the Department until several days after the importation. Permit was withheld and the Bureau's inspector at New York promptly directed to identify the animals. On ascertaining that they were fruit bats, the Bureau notified the collector of customs at New York, whereupon inspectors of the Customs Service in Chicago promptly sought, seized, and destroyed the bats, notwithstanding vigorous protest by zoological-park officials. Like disposition was made of another bat at New York before it reached its destination on

Staten Island. In this case the application for the permit was sent prior to the arrival of the consignment, and the bat was listed as such.

Seven common Indian mynas (*Acridotheres tristis*), an injurious species not permitted entry by either Federal or California law, arrived at San Francisco in March. After identification by the inspector, the birds were returned to the shipper in Papeete, Tahiti, on the steamer that brought them in.

SPECIES ENTERED UNDER PERMIT

BIRDS

Importation permits issued during the year numbered 1,475, an increase of 289 over the number in 1934, and inspections decreased from 175 to 145. Fourteen additional permits were issued at Honolulu, Hawaii, for the entry of 136 miscellaneous birds. The 197,100 foreign birds imported (a decrease of 66,635 from last year) included 138,756 canaries, 1,783 parrots, 23,358 Mexican quail, 6,000 valley quail, 2,211 Hungarian partridges, 203 pheasants, and 24,789 miscellaneous birds.

Bobwhite quail were imported from Mexico to the number of 23,358, nearly 10,000 more than last year. Mexican Government concessions had been granted to five individuals for the exportation of 65,000, the entries of which were made at the ports of Eagle Pass and Laredo, Tex., where health examinations were made and permits issued by inspectors of the Bureau of Animal Industry, cooperating with this Bureau. The quail were shipped mainly to nine States, as follows: Texas, 11,735; Indiana, 7,240; Kentucky, 1,500; Mississippi, 1,326; Arkansas, 400; Florida, 200; Illinois, 184; Georgia, 150; and Missouri, 126. Of the remainder, small lots were shipped to New York, Pennsylvania, California, Wisconsin, Tennessee, and Louisiana.

About 6,000 valley quail were imported from Baja California by the California Fish and Game Commission for stocking purposes in southern California.

Hungarian partridges continued to be imported from Canada principally for stocking purposes in Ohio and South Dakota. Twenty-six chukar partridges (*Alectoris graeca chukar*) were imported from India.

Pheasants of several species were entered, including 25 copper pheasants (*Graphephasianus soemmerringii*) and 4 Mikado pheasants (*Syrmaticus mikado*) from Japan, 2 crossoptilon pheasants (*Crossoptilon crossoptilon*) and 4 Lady Amherst pheasants (*Chrysolophus amherstiae*) from China, 3 Malay crested fire-backed pheasants (*Lophura rufa*), and 4 argus pheasants (*Argusianus argus*) from Singapore, Straits Settlements.

To prevent psittacosis, the Public Health Service still limits the importation of parrots to birds 8 or more months old and continues the 15-day quarantine and the restrictions on interstate transportation. Among the more interesting parrots imported were 2 Finsch's parrots (*Amazona finschi*) and 2 Petz parrakeets (*Eupsittula canicularis*) from Mexico; 1 eclectus parrot (*Eclectus roratus*), 2 cockatoos (*Kakatoe haematuropygia*), 1 mealy rosella parrakeet (*Platycercus adscitus palliceps*), 2 blue mountain lories (*Trichoglossus moluccanus*), and 1 blue-tailed lory (*Eos histrio*) from the Philippine Islands; and 1 tovi parrakeet (*Brotogeris jugularis*) from the Canal Zone.

Other rare and interesting birds imported during the year included 6 Comoro weaver birds (*Foudia eminentissima*), imported into the United States for the first time; 12 Japanese waxwings (*Bombycilla japonica*); 6 buffalo weaver finches (*Dinemellia dinemelli*), 2 dwarf hornbills (*Tockus erythrorhynchus*), 3 Siamese raven hornbills (*Hydrocissa convexa*), 6 dwarf falcons (*Polihierax semitorquatus*), and 2 barn owls (*Tyto alba*) from Africa; 1 black Indian cuckoo (*Eudynamys scolopaceus*), 4 black-chinned flowerpeckers (*Yuhina nigrimenta*), and 5 blue-cheeked barbets (*Cyanops asiatica*) from India; 1 Sumatran barbet (*Thereiceryx zeylanicus*) and 6 bar-shouldered doves (*Geopelia humeralis*) from New South Wales; 6 Ridgway's scaled doves (*Scardafella ridgwayi*) and 17 bell birds (*Casmarhinchos nudicollis*) from Brazil; 2 stilts (*Himantopus melanurus*) and 4 blue and yellow tanagers (*Thraupis bonariensis*) from Argentina; 40 emerald tanagers (*Tangara guttata chrysophrys*) from Venezuela; 2 tanagers (*T. fastuosa* and *T. cyanocephala*), 1 black-faced tanager (*Schistochlamys atra*), 1 Diuca finch (*Diuca diuca*), and 1 red-breasted blackbird (*Trupialis defilippii*) from South America; 5 amethyst doves (*Phapitreron amethystina*) and 1 yellow-breasted fruit pigeon (*Leucotreron occipitalis*) from the Philippine Islands; 30 Abyssinian sun birds (26 *Cinnyris cruentata* and 4 *Cinnyris habessinica*), 21 lavender finches (*Estrilda caerulescens*), and 4 red-

crested finches (*Coryphospingus cucullatus*) from Holland; and 2 black-footed albatrosses (*Diomedea nigripes*) from Midway Island.

Near the close of the year application was made by the Byrd Antarctic Expedition for a permit to bring in 7 emperor penguins (*Aptenodytes forsteri*) and 1 Adelie penguin (*Pygoscelis adeliae*), taken in the Antarctic region, and 8 Galapagos penguins (*Spheniscus mendiculus*), obtained en route home. The Antarctic birds were transported in glass-enclosed refrigerators at a temperature of 30° F. With the exception of 2 Galapagos penguins retained by Admiral Byrd, all were sent to the Chicago Zoological Park.

MAMMALS

Black bear cubs from Canada, consigned principally to points in New Jersey, New York, Pennsylvania, and Minnesota, continued to be imported, the number aggregating 128 as compared with 96 last year. A few polar bears from Norway and a few cinnamon bears from Mexico also were imported.

Importations of monkeys included 5,073 rhesus monkeys from India and others in considerable variety, including chimpanzees, baboons, colobus monkeys, macaques, and bush monkeys from Africa and India; ringtails, marmosets, and woolly and moss monkeys from Central and South America; sykes and patas monkeys from Java; and 1 gorilla from West Africa. Among the monkeys was an exceedingly rare albino from the jungles of Colombia, South America, presented to the Central Park Zoo, New York City. About 10 years ago, it is reported, an albino like this one was found, but it died before it was 6 months old.

Other interesting mammals imported were 1 lion marmoset (*Leontocebus rosalia*) from Brazil; 1 hoolock monkey (*Hylobates hoolock*) from Hong Kong; 2 sea elephants from Guadalupe Island, Mexico, for exhibition at the San Diego (Calif.) Exposition; 4 vampire bats (*Desmodus rufus*) from Trinidad, British West Indies; 1 honey bear (*Ursus malayanus*) from the Malay Peninsula; 1 Arabian fox (*Fennecus famelicus*) from the Persian Gulf region; and 1 zorilla (*Ictonyx zorilla*) and 2 manatees (*Manatus americanus*) in miscellaneous shipments from Germany.

COLLECTING AND OTHER PERMITS ISSUED UNDER THE MIGRATORY BIRD TREATY ACT

One of the amendments of the Migratory Bird Treaty Act regulations, effective August 20, 1934, made the permits issued for collecting migratory birds for scientific purposes annual rather than indefinite or unlimited. Representations having reached the Bureau from various credible sources that such permits in some instances were being misused, all those outstanding were recalled, and new, annual permits were issued only in those cases where it could be determined that the applicant was well qualified for the privilege. The rule was also established of not including in taxidermists' permits the privilege of buying and selling specimens, as such a practice has lent itself to too many abuses incompatible with adequate protection of migratory birds.

There were outstanding at the close of the year 1,207 permits to collect migratory birds for scientific purposes and 3,878 for possessing, buying, and selling migratory waterfowl for propagation.

Only 52 permits were issued to capture migratory waterfowl for propagation. Reports of permit holders during the calendar year 1934 showed 54,737 wild ducks raised in captivity, of which 48,080 were mallards and 5,793 black ducks, the others mainly wood ducks, pintails, teals, gadwalls, canvasbacks, baldpates, and redheads. The number of wild geese raised under permit was 4,518. Migratory birds propagated and reported sold during the year included 7,488 ducks and 214 geese for food, and 7,090 ducks and 3,156 geese for propagation. To conserve the breeding stock of wild ducks and geese, the Department in April discontinued the issuance of permits to take waterfowl and their eggs for propagation, except for State refuges or in rare instances where experienced commercial breeders require the replenishment of wild stock.

BAITING PERMITS

The first Federal restrictions on waterfowl baiting, a practice now outlawed, were imposed by amendment of the Migratory Bird Treaty Act regulations for the fall and winter of 1934–35. The amendment provided for a seasonal permit to be issued without charge by the Bureau, with the conditions that no

waterfowl, except crippled birds not otherwise retrievable, should be shot while resting on water or land on any baited premises; that no waterfowl should be shot on such premises after 3 p. m.; that every permittee should keep an accurate record of the number of persons shooting on such premises, the number of blinds used, the number of each species killed, the number of birds taken each day by each gunner, and the kinds of feed and the interval of feeding; and that report of these facts be made to the Bureau within 1 month after the close of the season. Provision was made for revocation of the permit by the Secretary upon his determination that baiting on any premises constituted a disproportioned agency in the killing of migratory waterfowl, or for violation of any of these requirements. The amended regulation defined "bait" and "premises" with particularity, notwithstanding which the Bureau was called upon to answer numerous inquiries as to the scope and effect of the amendment, many of them being obviously captious or insincere, or proceeding from a hope of escape from the force of the reguluation.

Because of restrictions on baiting imposed by State law, no permits were issued in Alabama, Florida, Georgia, Iowa, or Minnesota, and no applications for permits were received from Idaho, Kansas, New Hampshire, Utah, West Virginia, or Wyoming. The bulk of applications were from California, 295; Illinois, 735; Maryland, 485; Missouri, 102; Oregon, 242; Virginia, 311; and Washington, 198. In the other States from which applications were received, the number in each was below 100, including New York, 90; North Carolina, 95; and Ohio, 65. Only 1 application each was received from Kentucky, Nevada, North Dakota, and Pennsylvania, and only 2 each from New Mexico, Oklahoma, and Texas.

The total number of baiting permits issued was 3,003, and the reports filed by practically all permittees, show that 44,349 gunners shot in the aggregate 673,083 birds on baited premises, the bulk of these being made up of 237,893 mallards, 187,452 pintails, 61,820 teal, 51,630 widgeons, 35,687 black ducks, and 29,834 scaups; and 3,628 coots were included. The kill of Canada geese aggregated 10,399; brant, 739; whitefronted geese, 441; and snow geese, 180. Mergansers to the number of 746 were reported. The largest kills of waterfowl on baited premises were in California, 210,258; Illinois, 166,014; Washington, 75,103; Oregon, 62,746; Maryland, 37,184; Missouri, 20,574; Ohio, 14,817; Virginia, 14,327; North Carolina, 13,781; and New York, 13,715.

Before the close of the season, 126 permits were surrendered on the cessation of baiting on the premises covered, and 3 permits, 1 each in Illinois, New Jersey, and Washington, were revoked by order of the Secretary, upon information that one or more terms of the permits had been violated.

COOPERATIVE CONTROL OF PREDATORS AND RODENTS

ABUNDANCE OF PREDATORS INCREASING

In spite of a large catch of predatory animals, several factors have operated to increase their numbers, especially those of coyotes, in most sections of their range. Among these factors are decreased cooperative personnel in organized control; inactivity among private trappers, because of extremely low fur prices; and the great fecundity of the predators.

Expenditures during the year in predatory-animal and rodent control operations, in addition to about $900,000 from emergency funds, included $441,354 from regular departmental appropriations, supplemented by $253,365 spent by cooperating States and $619,374 by cooperating counties, livestock associations, and others. The year's catch of predators, 66,662—the largest ever taken in 1 year by the Bureau and its cooperating agencies—consisted of 59,289 coyotes, 1,332 wolves, 5,380 bobcats and lynxes, 7 ocelots, 305 bears, and 349 mountain lions. Rodent control involved the treatment of 32,751,372 acres infested with prairie dogs, ground squirrels, pocket gophers, jack rabbits, porcupines, field mice, cotton rats, kangaroo rates, and woodchucks. In addition, 182,333 premises were treated in cooperative campaigns for the control of the common brown rat.

An example of the fecundity of coyotes was furnished in the San Luis Valley of Colorado, where 17 coyote whelps were taken from a single den together with the mother coyote, examination of the uterine scars of which showed clearly that all 17 belonged to the same litter. A second litter of 17 was taken from a coyote den in northwestern Colorado, and a den of 16 wolf whelps was taken in Jefferson County, Okla. On lambing grounds in one

township, 6 miles south of Wolcott, in Carbon County, Wyo., 44 coyote pups and 1 adult were taken from 5 dens, containing 6, 7, 8, 9, and 14, respectively. The stockman apparently had ample reason for complaining of severe losses among his lambs. In the south Texas area, embracing that section of the State south of a line from Victoria to Del Rio, which probably contains three-fourths of the coyote population of the entire State, increasing numbers of reports were received during the year of damage by predatory animals to young deer and calves. In the comparatively small area where some measure of predator control has been attained in Texas, a noticeable increase in the game population has been observed.

Increased abundance of predators has resulted in greater depredations on livestock, game species, and ground-nesting birds. This is evidenced by reports from livestock owners and by observations of the field personnel of the Bureau. The 3-year drought conditions prevailing over a great part of the West have to some extent concentrated the livestock around available water supplies, and as it also had the same effect on the predator population, it may have been indirectly responsible for greater losses in domestic livestock as well as in game species. The fact remains that predators have been more numerous and their depredations more severe, and also that the Federal Government has a distinct obligation to assist in the prevention of undue depredations to livestock and game species ranging on and adjacent to public lands. This obligation is now of direct financial interest to the Federal Government because of its financing loans to stockmen.

SELF-PHOTOGRAPHY BY WOLVES

This year for the first time, equipment was developed whereby wolves have photographed themselves in the wild. This was accomplished in a cooperative expedition, undertaken by the Bureau and the Chicago Academy of Sciences, in Madison Parish, La., where, by a special device, flashlights were set off by an electric current closed by the wolf when approaching the set. Several valuable study photographs thus made by the wolves themselves were obtained and published by the academy in its report on the expedition.

PROGRESS IN RABIES SUPPRESSION

A summary of examinations made by the Nevada State Veterinary Control Service for the years 1915 to 1933 shows a steady decline in rabies in that State during this 19-year period. Predatory-animal control work was orginally inaugurated by the Bureau in 1915 for the primary purpose of stamping out a severe outbreak of rabies in Nevada, and has been largely responsible for its general suppression.

In August 1934, officials of the health and game departments of Maine urged that aid be given in controlling an outbreak of rabies near Farmington. The Biological Survey learned that the trouble was localized in a farming section largely wooded, not over 8 miles in diameter, where 10 foxes with evidence of rabies had been killed during the spring and summer. One boy, 3 cows, and 4 dogs were known to have been bitten by the foxes, and 2 of the cows had died. A rapid spread of the disease among the numerous large and small wild animals was threatened, but acting on the Bureau's recommendation the State game department immediately employed 10 trappers to remove all possible carriers. By October 1 these men had taken 162 foxes, 107 raccoons, 510 skunks, 117 porcupines, 9 minks, 67 woodchucks, and numerous squirrels, muskrats, weasels, and vagrant cats. This action brought the situation under control.

NEED FOR RODENT CONTROL CONTINUES

The need for rodent control throughout the Western States has been greatly augmented by the fact that the prevailing severe drought conditions have caused many species to migrate to areas where food supplies were available. This usually resulted in rodent concentrations on cultivated areas and on fertile range lands of more succulent vegetation.

BUBONIC-PLAGUE CARRIERS

With the finding of bubonic plague in the Oregon ground squirrel in Lassen County, and in the white-footed mouse in Modoc County, there are now 14 counties in California in which the disease has been demonstrated among native rodents. In California it has now become definitely associated with

4 native rodents—2 species of ground squirrel (*Citellus beecheyi* and *C. oregonus*), the wood rat (*Neotoma cinerea*), and the white-footed mouse (*Peromyscus* sp.), and, in addition, the introduced brown rat (*Rattus*). The fact that the disease has now been established in white-footed mice and that these rodents, as well as wood rats, live in unoccupied habitations of man, increases the public concern, since old cabins, shacks, barns, and cellars are used on occasion by stockmen, ranchers, hunters, and wanderers.

EMERGENCY CONTROL PROGRAMS

FEDERAL EMERGENCY RELIEF ADMINISTRATION

Cooperation of the Federal Emergency Relief Administration in predatory animal and rodent control in 10 States—Washington, Oregon, Idaho, Montana, Wyoming, Utah, Texas, Massachusetts, Alabama, and Mississippi—accounted for the destruction of 12,695 predatory animals, and the treating of 2,551,026 acres for the control of field rodents and of 139,069 premises in rat-extermination campaigns.

The Montana Relief Commission expended $48,560 for the control of prairie dogs in a project carried on under the supervision of the Bureau in 8 counties of eastern Montana. In the course of the work 450,000 acres of prairie-dog-infested territory were treated, more than 64,000 man-hours of employment were provided in a drought-stricken area, and checks were issued to laborers amounting to $37,733. In the more heavily infested districts this rural project reached and directly benefited practically every individual. For years ranchers in this section individually had been making futile attempts to control prairie dogs, and it was not until the concerted action of this year was taken that success was attained. The presence of millions of prairie dogs competing with livestock on the range during drought periods is a matter of serious concern to stockmen. In many instances, in Custer, Powder River, Carter, and Rosebud Counties in this campaign, these rodents were found virtually in possession of the most desirable grazing areas on section after section of contiguous land, and they were rendering unproductive thousands of acres of otherwise valuable stock lands.

PLAINS SHELTERBELT PROJECT

In cooperation with the Plains shelterbelt project of the Forest Service, in the strip extending from North Dakota to Texas, through South Dakota, Nebraska, Kansas, and Oklahoma, 125 miles of shelterbelt plantings were furnished with protection against rodent damage. Investigations were first carried on through this strip to determine the most effective methods of controlling rodent pests as they affect shelterbelt plantings. Jack rabbits and pocket gophers are especially destructive, the jack rabbits doing damage to young trees from aboveground, while the pocket gophers attack the roots. Such a menace are these mammals to young trees that, if not kept under control, they will jeopardize the shelterbelt plantings during the period the trees are attaining some size.

NATIONAL INDUSTRIAL RECOVERY ADMINISTRATION

Emergency P. W. A. funds transferred to the Bureau from the Forest Service made it possible to treat 1,864,389 acres of national forests for the control of prairie dogs, ground squirrels, kangaroo rats, pocket gophers, and porcupines in nine States—Oregon, California, Idaho, Nevada, Utah, Wyoming, Colorado, New Mexico, and Arizona.

EMERGENCY CONSERVATION WORK

Rodent control was continued as a project in Emergency Conservation Work in cooperation with the Forest and Soil Conservation Services, of the Department of Agriculture, the Office of Indian Affairs, the Bureau of Reclamation, and the Division of Grazing, of the Department of the Interior, and on big-game preserves of this Bureau. Under the program drawn up it was possible to treat 1,886,395 acres of national-forest lands, 138,960 acres on soil-conservation projects, 3,877,897 acres of Indian lands, 59,300 acres on reclamation projects, 161,185 acres of public domain, and 43,395 acres on big-game refuges for the control of injurious rodents, the work of which, in destroying range grasses and other soil cover was contributing measurably to the erosion of

valuable surface soil. On Indian reservations capable foremen were placed in charge of crews of Indian laborers. The Indians, noticing the good results obtained by taking the rodents from their farm lands and adjacent areas, worked with renewed interest and vigor to benefit as much as possible from the project. By reducing the rodent population over wide areas in the cooperative work, great reservoirs of breeding rodents that had for years constantly reinfested adjacent cleared agricultural lands have been held in check. The reduction in the rodent population is now making it possible for the grass to grow on extensive areas in arid and semiarid regions. With such rehabilitation of the ground cover, disastrous erosion of the soil will naturally be lessened in intensity in places where it is now noticeable, and will be prevented on other large areas.

DROUGHT-RELIEF PROJECTS

Drought-relief funds aggregating $15,000, provided for the control of rodent pests on drought-stricken areas in Idaho, made it possible to reduce the rodent population on 593,445 acres. The State drought relief committee estimated that a net saving of more than $400,000 worth of range forage, feed, and grain crops resulted from the jack rabbit control work alone, which was conducted on 425,776 infested acres.

Damage to farm products by the drought was further aggravated wherever the jack rabbits congregated in hordes to find an available food supply. This situation was emphasized in eastern Colorado by a petition, bearing the signatures of more than 9,000 persons, asking for immediate assistance looking toward the elimination of jack rabbits that were devouring what little livestock food remained after the drought of 1934. Incidentally, these petitions requested that the Federal Government provide a bounty of 10 cents a head on jack rabbits, but the Bureau's experience has shown that the payment of bounties is a most unsatisfactory means of controlling mammal pests, and that much better results can be obtained by organized control carefully planned and supervised by expert leaders.

BAIT-MIXING STATION

The Bureau's cooperative bait-mixing station at Pocatello, Idaho, has been a primary factor during the past season in the efficient conduct of rodent-control campaigns, not only on regular projects, but on those financed through emergency funds as well. Scientifically treated baits prepared at this station were utilized in Emergency Conservation Work operations on Indian Service, Forest Service, and Division of Grazing Lands, and on Biological Survey refuges; in National Recovery Administration work; and in soil-conservation cooperation; and also in regular Federal work and cooperative programs with States, counties, farm bureaus, and other organizations. Since its inception the station has shown a yearly increase in production and service. New mechanical devices added to the equipment from time to time have made possible a bait that is much more uniform than heretofore and gives greater success under field conditions.

Supplementing the scientific mixing of poison-grain baits has been the large-scale manufacture of pocket-gopher probes developed at the Control Methods Research Laboratory in conjunction with district agents of the Bureau. These probes have been standardized in two types, so that they will generally serve the requirements of all districts. Automobile trailers for field use in transporting bait and equipment also have been made up in the work shop of the bait-mixing station. The development of a warehouse for storage of field equipment for the Division of Game Management is rapidly becoming another of the major features of this station, and it is planned later to store standard field equipment at Pocatello to prevent delays in supplying material requisitioned by field men.

CONTROL METHODS RESEARCH

An important aid to field agents engaged in the control of injurious mammal pests is the laboratory maintained at Denver, Colo., to carry on research in improved methods. Rodents and predators living in close relationship with human activities develop resistance to methods of control when these are used for a period of years. Constant study is required to perfect improved methods, in order that the operational forces may keep injurious mammals within reasonable bounds.

The Control Methods Research Laboratory during the year carried on special studies for the control of field mice in Virginia. Orchardists in the Eastern States have experienced considerable difficulty in several localities after using strychnine-treated grains over a period of years. Based on the new studies, a change in baits will probably be recommended for those areas where control has proved exceptionally difficult.

Studies also have been carried on in the laboratory looking toward the development of successful repellents to prevent damage to seedlings by rabbits, mice, and ground squirrels. Of special aid in reforestation projects is the progress that has been made in perfecting a poisoned spray for treating seedlings before transplanting from seed beds.

Progress also has been made in the development of a fumigant for use in burrows of prairie dogs and ground squirrels. The Bureau has studied this problem for several years in an attempt to develop a cheaper and more effective fumigant.

The laboratory is conducting an interesting study of coyote migration, to learn the effects of this habit on stockraising and on control methods. Of 9 coyotes tagged and released in January 1931, returns from 4 have thus far been received. During the first half year 2 were caught within 5 miles of the point of release. At the end of the first year 1 was trapped approximately 100 miles north, it apparently having been following along the range of mountains, as there had been no general movement of stock through this section that might have influenced its direction. The fourth coyote was taken recently within 5 miles of the point where released 4 years previously. More extensive tests are being made in other localities to gather additional information on the migrations of these predators.

Information on control issued during the year included two mimeographed leaflets of the Bureau, one (BS–7) giving instructions for controlling bats, the other (BS–10) on secondary poisoning from thallium used in rodent control.

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